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REASONABLE RATES.

Is it unreasonable for a public-service corporation to earn more than six per cent on the value of its property?

Some press comments on the recent case of Wilcox vs. Consolidated Gas Company appear to answer this question in the affirmative, but such a view can hardly be sustained.

What this case does decide on the point in question is simply that rates fixed by the legislature that yield an annual return of only about six per cent on the value of the gas property are not so unreasonable as to be null and void. The further question as to what rate of return on the value of its property the company might reasonably earn in the absence of government regulation is thus left open, as will appear from the following:

To understand the scope of the decision in the Wilcox case it is necessary to have in mind the exact ground on which this decision as to the rate of return is based, and this ground is none other than the Fourteenth Amendment of the Federal Constitution, which provides:

"Nor shall any state deprive any person of life, liberty, or property without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws."

It is evident that the words of the Amendment just quoted are negative, merely saying what may not be done by any State, and it is the duty of the Supreme Court of the United States to interpret the nature and extent of the limitation thus imposed on State powers.

How high the rates for public service should be put, in the absence of government regulation, or by government regulation, may depend in part on matters of economic or political policy. How low a State may go in fixing rates is for the Supreme Court to decide.

When fixing the lower limit of State regulation the Supreme Court is not concerned with the question of what rates will attract fresh capital and cause the expansion of a particular industry, or with the question of what rates will best promote the general welfare, but rather with the problem whether the rate in question is so low as to "deprive any person of * * * property without due process of law."

It may thus befall that a rate fixed by a legislature, while lower than that dictated by the desire to promote an industry, or by good public policy, may still be high enough to escape the prohibition of the Fourteenth Amendment, as interpreted by the Supreme Court.

A number of cases indicate that the limits set to State regulation of rates by the Supreme Court represent merely

the protection of property rights rather than a policy for the upbuilding of industry. This was clearly brought out in the opinion of the Court in the case of St. Louis Electric Railway vs. Gill, 156 U. S. 649, where it was said:

"This court has declared, in several cases, that there is a remedy in the courts for relief against legislation establishing a tariff of rates which is so unreasonable as to practically destroy the value of property of companies engaged in the carrying business, and that especially may the courts of the United States treat such a question as a judicial one and hold such acts of legislation to be in conflict with the Constitution of the United States, as depriving the companies of their property without due process of law, and so depriving them of the equal protection of the laws."

It is particularly to be noted that the relief to be obtained from the courts, according to the opinion just quoted, is only against legislative rates that are "so unreasonable as to practically destroy the value of property," which may be decidedly lower than rates that would be reasonable from other points of view.

STREET LIGHTING IN EUROPE.

A high degree of street illumination with public lamps is more generally provided in Europe than in the United States.

This result is attained in Europe by the use of high-candlepower lamps and by spacing all lamps at moderate distances apart. In Berlin some of the flame arc lamps consume as much as 825 watts each, and parts of the same city are lighted with high-pressure inverted gas burners, mounted three on the same standard, the consumption of gas at each standard being eighty-five cubic feet per hour. Along the Potsdamer Strasse these high-pressure gas standards are located 130 feet apart, with the incandescent mantles 17.5 feet above the pavement, and their mean lower hemispherical candlepower is said to be about 3,300.

Open arc lamps with plain carbons and flame arc lamps with cored carbons are suspended thirty-three feet above the roadway in Berlin, and in some of the public squares the so-called intensifying flame arc lamps are fixed fifty-nine feet above the ground. Such elevations for arc lamps, of course, contribute much toward uniform illumination.

Low-pressure inverted gas burners in some of the Berlin streets are located on columns ninety-two feet apart, each column carrying four burners with mantles 14.75 feet above the pavement that consume sixteen cubic feet of gas per hour.

At Ludgate Circus and on Ludgate Hill, London, the flame arc lamps recently installed operate with eleven amperes each, and along Manningham Lane in Bradford, England, the flame arcs take eight amperes each and are 120 feet apart. These flame arc lamps on Ludgate Circus and Hill were erected especially for comparison with the high-pressure inverted gas lamps on Fleet Street, as well as those along Aldwych and Kingsway.

Each of the Fleet Street high-pressure lamps is rated at 1,500 horizontal candlepower and consumes twenty-five cubic feet of gas per hour at a pressure of about fifty-five inches of water. To supply gas at this pressure the gas company has laid a special six-inch main along Fleet Street from its compressing plant. Each mantle is about sixteen feet above the pavement and the lamps are 120 feet apart on opposite sides of the street. From this account of the exhibition of high-pressure gas lighting on Fleet Street it may be gathered that the gas company is making an effort to secure a share of the London street lighting. Such an effort will probably be made at some points in the United States, and is, in fact, understood to be now under way at Boston.

The flame arc lamps above mentioned at Bradford are rated at 2,500 candlepower each and are located twenty-three feet above the ground.

As showing the extent of the gas and electric competition for the street lighting at Berlin, the gas company has laid special high-pressure mains along about twenty-five miles of streets there for the exclusive purpose of operating public lamps. These lamps are lighted and extinguished by changes in the gas pressure, so that it is impracticable to use these high-pressure mains for the supply of private consumers. Two compressing stations are operated for the sole purpose of supplying the high-pressure street lamps. According to the published tests of the gas engineers, the high-pressure gas lamps consuming eighty-five cubic feet per hour, in use on the Potsdamer Strasse, give an illumination equal to that of the ordinary open arc lamps at forty to forty-five degrees below the horizontal.

In comparison with the flame arc lamps on the Potsdamerplatz and the square at the Brandenburg gate the eighty-five-foot-per-hour gas lamps are said to give more illumination in the vertical plane above forty degrees and much less below forty-five degrees, reckoning in each case from the horizontal plane through the gas mantle and the electric arc.

THE VALUE OF THE COMMONPLACE IN ELECTRICITY.

One of the sermons which made a lasting impression on our youthful mind—years and years ago—used the same text as that of many other sermons which have been profitably forgotten, namely, the parable of the prodigal son.

In this instance, however, the clergyman dismissed the reprobate whose repentance was developed by approaching starvation, with a few curt words and bent his discourse upon the dutiful son who stayed at home.

The spectacular part of occurrences overshadow the sober labors which establish unobtrusive but efficient conditions of safety, and whose infraction is followed by disaster.

Railroad service is possible with present speeds and density of train occupancy only through the protection afforded by electrical signaling systems wrought out by the experience of skilled inventors, and operated by intelligent and faithful men.

Through disregard of such signals or by other mischance let the inevitable result of trying to pass on the same track occur, and the headlines of the daily press will abound with

emotional acts of those who naturally hustle when in a bad scrape, but the signaling system which has made it safer to ride in a car than to walk on the street, is ignored.

A short time ago the people were aghast at the terrible collision between two passenger steamships while rushing through a dense fog before sunrise. The wireless system on one vessel summoned help; notwithstanding the interruptions from precocious amateurs all along shore for 500 miles each way, the loss was but little more than that of the property, instead of foundering with perhaps a few to tell the tale.

How few think of other comparable accidents which have been averted by the wireless service, and how much it has contributed to more rapid travel by the conditions of greater rapidity which this service establishes by making such speeds safe.

This occurrence means that all seagoing steam passenger vessels must be equipped according to the state of the art in what constitutes safe navigation.

The new wireless tower to be erected by the Navy Department at Washington will emit waves which can be caught by vessels 3,000 miles distant, and its constant value will not be limited to the facility of communication, but in the signaling of meridianal noon, which it will send each day.

Instead of testing of chronometers at the end of a voyage and the carefully ascertained rate of error in an observatory, which is only an approximation to the rate which the instrument will take when returned on shipboard, every ship's chronometer within this radius of 3,000 miles can be compared each twenty-four hours if the craft only be equipped with the wireless apparatus to intercept these waves.

Think of the value of this daily spark to safe navigation in the determination of longitude, with an accuracy hitherto impossible at sea.

On land the standard time sent over the telegraph lines each noon has been of incalculable value in the establishment of safe and prompt train service.

The simultaneous dropping of signal balls or strokes on fire-alarm bells, or discordant steam whistles and other ways of disseminating the truth of the flight of time are furnishing a just measure of that which comes to mankind but once, and yet is coming in the future as it has in the past.

For the measures of that which marks the life effort, there is the obligation of civilization to electricity as the most valuable servant of mankind.

ACCURATE COAL RECORDS IN POWER PLANTS.

A review of recent costs of power production in a number of central stations discloses the fact that in not a few instances the companies are without accurate knowledge of the quantity of coal burned in any given period under their boilers. The total cost of coal of one kind or another purchased during a month or year is generally known to the last cent, if any sort of respectable accounting is in force, but when it comes to the tonnage burned on the grates of the fireroom, it is frequently the case that the company does not know within from fifty to 100 tons what the yearly quantity was. This means that several hundred dollars' worth of fuel has been paid for in many instances without the certainty of securing the heat units delivered by the coal companies, and it is a source of waste which ought to be removed, certainly in all plants where hand firing is in vogue.

If coal shipments are checked up as they should be by central stations, wherever the fuel is weighed, there ought not to be any such discrepancy as a ton or two a week between the coal bought and the coal used plus that remaining in the bins at the end of the year. It is not a difficult matter to calibrate a bin so that when it is leveled off, the amount of coal remaining in it can be determined with a fair approximation to accuracy. It is also a comparatively simple matter to train firemen to record their barrow loads on a simple track scale or platform scale in the floor of the boiler room, or, even, in cases where scales are not installed, to determine the number of barrow loads handled in a given time by the very plain method of requiring the fireman to pull the register cord of an old trolley cash-fare indicator every time he brings a new barrow load into the room. A little personal inspection on the part of the manager of the company will often help matters at the coal pile, and prevent spilling, inaccurate weighing, short deliveries, and excess loading of barrows.

Aside from the loss of valuable heat units when there is a considerable tonnage of coal unaccounted for in the yearly tabulation, it is inevitably the case that the company cannot tell what its cost of power production is with the same degree of confidence as when effort is made to keep a close record of the fuel handled. Thus, a station consuming 1,500 tons of coal per year at a cost of $4 each, spends $6,000 for its fuel, and if 150 tons are unaccounted for, the company is practically $600 out of pocket. In other words, the actual coal consumption paid for per kilowatt-hour produced is raised ten per cent above what it would be if all the fuel were accounted for, and this means, on a fuel cost per kilowatt-hour of 0.8 cent on the actual weight of coal burned, that the company pays for fuel at the rate of somewhere around 0.88 cent per unit of energy produced. Now this is not a very large proportion of the total sum that the company has to expend for its production of energy, considering all the other items that enter the cost of manufacture, but in these days of close station economies it means something to lose even 0.08 cent per kilowatt-hour. Then, too, it introduces the chance for error in the interpretation of operating figures, since a change in the equipment may be made for the purpose of economy, and on account of the inaccurate determination of the pounds of coal consumed per kilowatt-hour delivered at the switchboard, the company may not be able to find out what the real benefit of the new arrangement of equipment is, since the total saving may be eaten up by the waste in fuel. It is by no means uncommon for a simple improvement to be installed in a plant which nets the company only $300 to $500 per year, and this is often the value of the coal which goes into the unaccounted-for column when the station's annual returns are made up. A dollar saved between the coal pocket and the furnace is as good money as that saved by special economies in the combustion process.

SLOW-SPEED DRIVE OF SINGLE-MOTOR WEB PRESSES.

BY S. H. SHARPSTEEN.

The printer who buys a web press and wants an electric motor to drive it, may call in a motor salesman who has not had experience in equipping presses with motors. Then, when the printer tells him what the press builder specifies as the required motor capacity and speed variation, the salesman naturally quotes a price on a motor and rheostat for armature control.

Consider that A, in Fig. 1, is the armature of a 30-horsepower motor, geared to a Hoe quad press. It is natural to suppose, at first thought, that when the controller-arm H is moved to the right over the controller points 1, 2, 3, etc., and sufficient resistance is removed from the circuit of armature A, the armature will start the press, and both motor and press will move slowly at a constant speed for "threading" purposes. However, the mechanical resistance of the press at standstill is so much greater than the slow-running resistance that after the press starts it increases in speed rapidly, unless the man at the controller-arm H has practiced with the equipment and can quickly swing the arm H back and forth over the first points in the controller dial and get a slow speed by producing the proper number of power impulses.

A web press contains a large number of gears, pinions, bearings, and many tons of machinery possessing inertia, all of which requires more power to start than is necessary to keep running slowly for threading.

When the press is in good working condition it will move slowly for threading while H is on point 1, but after standing for a short time H may have to be placed as far as point 4 before the press will start. If, when H is on point 1 and all the armature resistance is in circuit, the motor produces sufficient power to move the press for paper threading, it is evident that when H is started on point 4 and approximately one-fourth of the armature resistance is cut out of circuit, the motor after starting will drive the press at a speed that will snap the paper if threaded, or move the machine so rapidly that the pressmen are liable to get their fingers caught as they feed in the paper.

The manager of a newspaper often buys a larger motor than is necessary to drive a web press. In a case of this kind a salesman sometimes sells a twenty-horsepower motor and controller to do ten-horsepower work. When the equipment is installed and started, it is discovered that the armature resistance in the controller was designed to pass current sufficient to operate a twenty-horsepower load. The result is that the press speed cannot be properly controlled until a new controller is furnished or the resistance changed in the one first sent. Having the motor large for the work is not detrimental to the operation of the equipment, but the controller should have its resistance designed for the work to be done.

If the press starts on point 4 today, tomorrow the temperature of the press-room might be low, causing ink, grease and oil to hold the press in such a way as to require H on point 5 or 6 before the press would move. There are so many things that can change the starting and running torque required by a press, that simple armature control is not satisfactory.

Fig. 2 illustrates a plan of armature control that will give a constant slow speed for plating and threading purposes. A is the armature, FF the field magnets, and BB the brushes of a motor installed to drive a web press. As in Fig. 1, the points 1, 2, 3, . . . 11 are the armature resistance blocks in the controller-dial D. Consider that the armature resistances, R, R', etc., are designed so that when the service switch SS is closed and the small switch S is placed in jaw t', the arm H contacting on point 2, enough current will pass to start the motor and press under normal conditions. The result is that when ready to move the press for threading, if H is pushed to point 2, the equipment starts promptly and, as in Fig. 1, the tendency is to have the speed of the armature build up rapidly. But as the armature commences to revolve, producing a counter electromotive force, the higher voltage at the brushes BB sends the surplus energy through the resistance R (between points 1 and 2), and a portion of the resistance BR. This latter we will call a bridge resistance, because it is placed in multiple with the armature A. This bridge prevents the excessive increase of wattage in the armature and undue increase of voltage at the brushes BB. The result is that the armature will come to a predetermined speed and remain there, regardless of a normal change in load. While running slowly, if the paper tension should be increased and more power required, the motor will slow down slightly, hardly enough to be perceptible, reducing its counter-electromotive force just enough to allow additional current to pass to do the extra work.

The resistance of the armature at standstill is so low compared to that of the bridge that sufficient current passes through the motor to make a satisfactory start.

As the lever H is moved on toward the right to get producing speeds, the resistance formerly in circuit with the

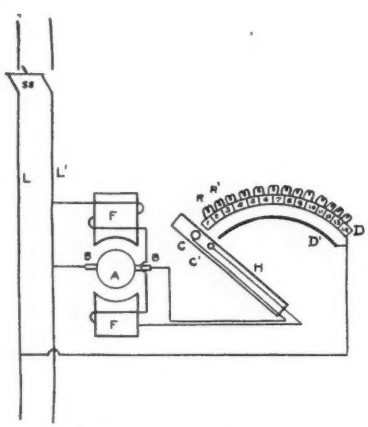


FIG. 1.—STRAIGHT ARMATURE CONTROL.

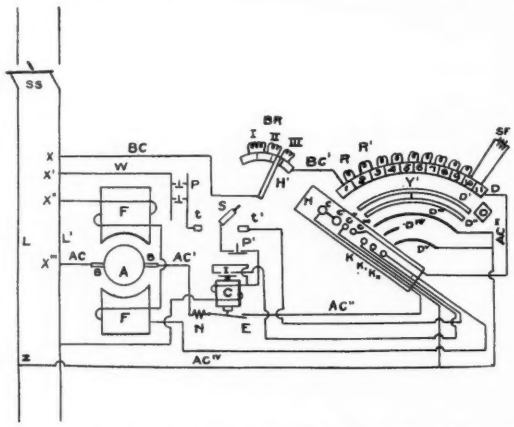


FIG. 2.—ARMATURE CONTROL FOR CONSTANT SLOW SPEED.

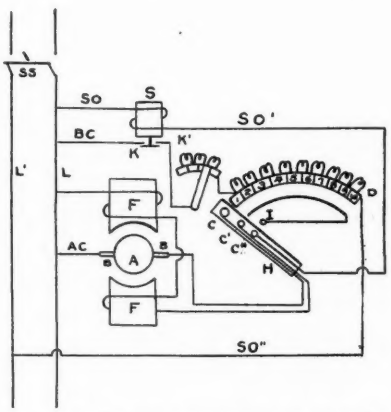


FIG. 3.—BRIDGE OR SHUNTED ARMATURE CONTROL.

armature is placed in the bridge as con troller-brush C passes over the blocks in controller-dial D. When the controller-arm gets to the point where controller-brush C leaves the dial D, the armature circuit is kept closed by controller-brush C′, on plate O, through controller-brush C″, and wire AC^{IV} to line L at Z. Thus the bridge is removed when the armature is running for production, keeping the efficiency of the electrical apparatus up to the proper point. The bridge decreases the efficiency at starting and threading something below that of the customary armature control, but, since threading runs are very short, the efficiency of the motor at such times has but small effect on the gross consumption of current used to operate the press. At low speeds and while getting the equipment up to production speed, the main armature circuit leaves the line L′ at X‴, and is made up of wire AC, armature A, wire AC′, blow-out coil N, contactor E, wire AC″, controller-brush C, armature dial D, resistances R, R′, etc., series field SF, wire AC‴, controller-brush C‴, dial D″, wire Y′, dial D′, controller-brush C″, wire AC^{IV} to the other side of the line, L at Z.

When the controller-arm H is in a position that places controller-brush C on point 2 of dial D, the bridge leaves the line L′ at X, and is made up of wire BC, the small controller-arm H′, all or part of resistance BR, wire BC′, and resistance R From controller-brush C, back to line, the bridge circuit is identical with the armature circuit.

While running for production, dial D with its resistances and the series field SF are out of circuit, as mentioned above.

Web presses usually require quite a large range of variation production speeds, and good practice demands that it be obtained by means of field control or by varying the field strength rather than by using resistance in circuit with the armature. If quite a large range of speed control by the field is desired and an interpole or similar motor is not used the motor should be compound-wound to prevent excessive sparking when the press chances to start with difficulty. The compounding, or series field, may interfere with the shunt-field regulation during production. As the series field is not necessarily of any use at such a time, it may be cut out, as shown in Fig. 2.

A contactor or automatic switch C used for the main controller make-and-break, will prevent arcing between the controller-brush C and point 1 of the dial D.

When running for production, with the switch S closed in jaw t′, a circuit running around the press with push-buttons and looped into the coil circuit of the contactor C can be used as an emergency stop by pushing the button P′, opening the exciting circuit of contactor C, and thus opening the armature circuit at E. A second press circuit with push-buttons P looped into the wire W can be used for moving the press slowly for threading or plating when there is no operator at the controller. In this latter case the controller arm would be placed so that controller-brush C stands on point 2, dial D, and the switch blade S is closed in jaw t. Now, when a push-button as P is closed, current passes through the exciting coil of the contactor C, independently of the

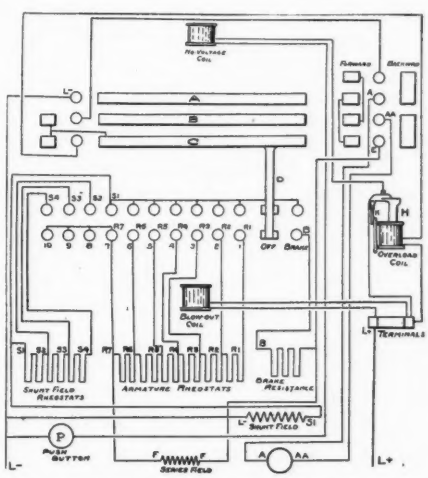


FIG. 4.—DRUM SERIES CONTROLLER FOR SMALL WEB PRESSES.

controller-arm H, and the armature circuit AC, AC′, etc., is closed on all the armature resistance save one coil that is included in the bridge, running the motor slowly with a uniform speed. When the push-button P is released the motor stops instantly.

If the bridge resistance BR is in sections I, II and III, and an arm H′ is provided, the flow of current through the bridge can be varied and the effect of the bridge on the armature speed changed.

Fig. 3 illustrates another plan of using the bridge or shunted armature in printing-press motor control. Consider that A is the armature of a motor geared to a printing press. Instead of the bridge circuit being permanently closed, as in Fig. 2, it is open at all times except when the controller-arm H stands on point 2 of controller-dial D.

When ready to operate the press for threading, the arm H is moved to the right until the press starts, which may be when controller-brush C stands on point 4. After the press is moving, if the armature and bridge resistances are properly designed and adjusted for the work, and when H is placed so that brush C stands on point 2 and brush C″ touches point I, current will pass through wire SO, the coil of S, wire SO′, controller-brush C″, point I, and wire SO″, exciting the solenoid S and closing the armature bridge BC at K and K′, causing the motor to operate at a constant speed. With this plan the armature control can be used without having a circuit across the line independent of the armature, while the motor is making long production runs. It is, however, more difficult to design and adjust the resistances to get satisfactory results. With the plan illustrated in Fig. 2 the controlling effect of the bridge can be used on a wide range of speeds.

For about ten years there have been in use, for magazine work, small web presses that have a low production speed, and are so designed that the paper can be easily threaded. These require from seven to ten horsepower to drive for production, and have been well operated with a type of drum series controller, illustrated in Fig. 4.

When the maximum speed of a web press is so low it is much easier to use armature control for threading and plating.

There are three copper bands, A, B and C, on the movable drum that are used for controller main make-and-break, which are protected by a magnetic blow-out—the blow-out coil only being shown. A lever and contact-shoe or brush are supported on the bottom part of barrel-shaft D, which moves over the points R′, R″, etc., in a manner similar to an ordinary flat-dial controller, with no magnetic blow-out. As shown, provision is made for three points, S_2, S_3 and S_4, for shunt-field control for production.

The controller handle and its shaft are held at each operating point by a small wheel forced by a spring into spaces on the circumference of a larger wheel, the large wheel being fastened to the controller shaft. When the service switch is closed the large wheel and the controller handle are locked to the controller barrel by a small dog or latch, that is held in locking position by current passing through the coil marked "No-voltage coil." If, while the press is producing, the push-

button P is pushed or the current is taken from the line, this dog releases the barrel, which is returned to the starting point by a spring. This feature makes an excellent no-voltage release and emergency stop. After employing this way of stopping the press, before the controller can pass current to the motor, the handle must be returned to the off position.

It is evident that while the press is standing and the service switch is open the controller handle can be moved back and forth without changing the position of the controller barrel. The current that excites the no-voltage coil passes through a small circuit-opening device at H in the overload cut-out. In case of an abnormal amount of current passing through the equipment, the overload coil would pull over the small lever K, cutting the current off the no-voltage coil and stopping the motor.

When this controller is used on a flat-bed equipment and reverse is required it can be had by the use of a reverse switch placed in one side of the controller and operated by a small handle on top of the controller case. The reverse connections are shown in the upper right-hand corner and are marked forward and backward. This plan allows the same number of reverse as forward speeds. The reverse lever interlocks with the larger one to prevent the reverse lever being moved while the press is running. The method of control illustrated in Fig. 2 is now in use at the plants of the New York *Evening Post* and the New York *Journal of Commerce*. The controller in both places are of the barrel type; the flat type is used for illustration.

The overload relay and dynamic brake have been omitted in the illustrations.

Electric Railways in Canada.

Construction of street-railway lines in Canada was almost stopped by the depression in 1908. For the entire year ended December 31 last there was laid a total of only thirty-three miles of track, and of this, half was built by one company, the Brantford & Hamilton line.

Electric-railway building at best is being done on a very small scale in Canada, as compared with its rapid development in the United States. In the year 1907 there was laid a total of only seventy-two miles of new track. The current year promises to be somewhat better, inasmuch as one line, the British Columbia Electric Railway, has now under construction more mileage than was built by all the roads in the past two years.

Highway Commission Inventories the New England Telephone and Telegraph Company.

The Massachusetts Highway Commission and the experts employed by it have been engaged for the past year in securing a careful inventory and appraisal of all property of the New England Telephone and Telegraph Company. The scope of the work was not limited to Massachusetts, but at the request of the company the appraisal was extended to include its property in Maine, New Hampshire and Vermont.

In its report the commission believes it to be of paramount importance that all unequal and discriminating rates of every nature should be done away with as rapidly as possible. Last year the commission submitted to the company a recommendation to that effect, and it is believed that the company is conforming to that recommendation as fast as existing contracts will permit.

It is almost equally important that the rates for service in the various localities and for the various classes of service should be so adjusted as to make them fair, not only to the public in general, but to each locality and to each class of telephone users, and this is the result which the commission hopes to accomplish.

As the result of a preliminary study the board last year recommended to the telephone company that the toll rates between Boston and sixteen suburban exchanges within a five-mile radius should be reduced from ten cents to five cents. This recommendation was made and acquiesced in by the company's officials, who immediately put the new rates into effect. In spite of this cutting of the gross revenues in half the consequent increase in business has brought the gross receipts from this source nearly up to the previous mark.

Prof. Dugald C. Jackson, an expert retained by the commission, said among other things that the company has 247 exchange central offices which provide telephone service for substantially every part of the commonwealth. Of these central offices forty-six are housed in buildings owned by the company, while the company owns seven other buildings in the commonwealth which are used exclusively for storage or general purposes.

The number of operators' positions at exchange switchboards, which aggregate 2,367, gives a truer idea of the extent of the telephone switchboards throughout the commonwealth than is obtained from a consideration solely of the number of central offices.

The total value of the physical plant used for local service in the commonwealth of Massachusetts is $22,885,082. This is the portion of the plant that is made use of to provide local service between subscribers whose circuits emanate from the same individual exchange central office, except that the seven central offices of metropolitan Boston are considered as the equivalent of a single exchange central office.

The foregoing total for local plant is divided in the following manner between certain important divisions of the commonwealth:

The total value of local plant in metropolitan Boston is $4,463,843.

The total value of local plant in the suburban district surrounding the metropolitan part of Boston is $6,446,838.

Of the latter total a value aggregating $3,983,940 lies within the inner zone now receiving five-cent toll service with the metropolitan district.

A value aggregating $2,462,898 lies in the outer zone now receiving ten-cent toll service with the metropolitan district.

The total value of local plant in the eleven cities of the commonwealth which, besides Boston, are of substantially 50,000 inhabitants or over, is $6,872,411. These eleven cities are Brockton, Cambridge, Fall River, Holyoke, Lawrence, Lowell, Lynn, New Bedford, Somerville, Springfield and Worcester.

The remainder of the local plant in the commonwealth is required for service in the smaller cities and rural districts, and its value amounts to $5,979,248.

In these divisions of local plant the property in Cambridge and Somerville comes into the total for the suburban district and also into the total for the eleven cities.

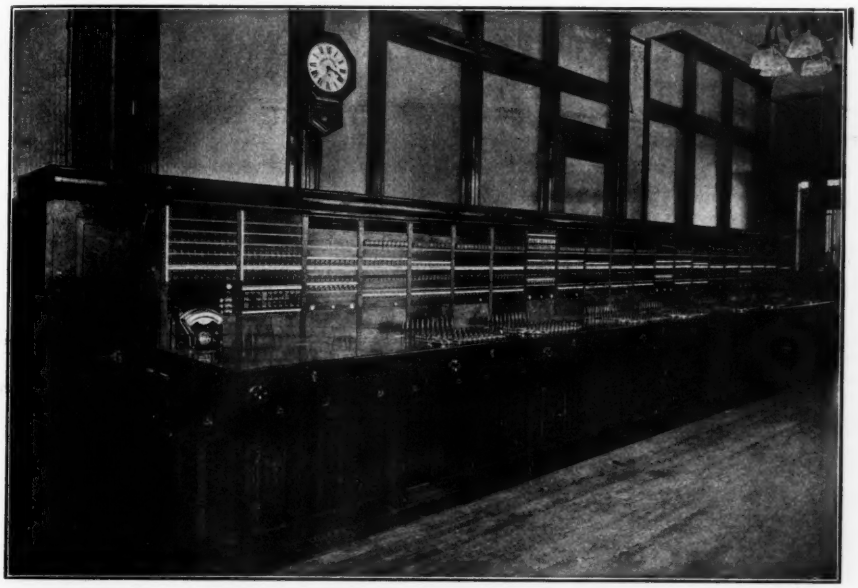
The total value of the toll plant for use in affording intercommunication between subscribers connected with different central offices is $9,641,913. It will be observed that this is a sum equal to forty-two per cent of the total local plant.

Telephone Growth in Alberta.

It is estimated that 800 miles of new telephone lines in the Province of Alberta will be constructed by the telephone branch of the Alberta Public Works Department this year. The mileage last year amounted to 800 miles, but the demands for this year are greatly in excess of this. Between 2,000 and 3,000 miles are considered necessary.

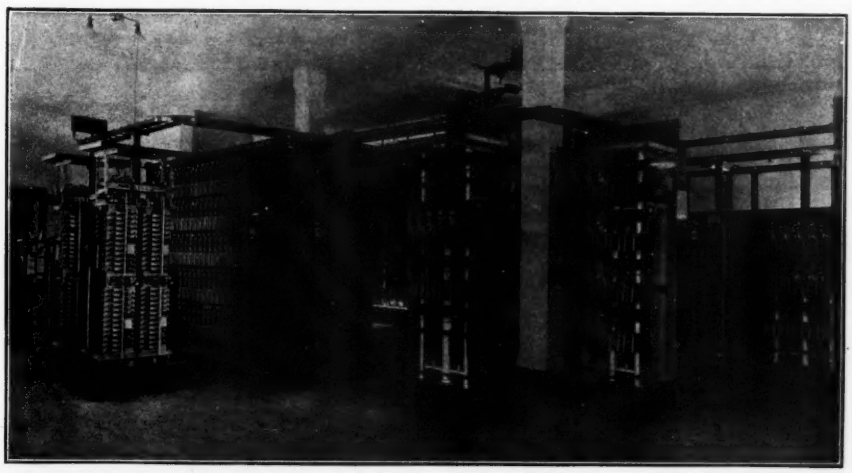
New Automatic Telephone Exchange at Lansing, Michigan.

The Citizens' Telephone Company of Grand Rapids, Mich., in keeping with its policy of providing the most up-to-date equipment in all its exchanges, has just finished the installation of a new automatic exchange at Lansing, Mich., where the company has owned the independent telephone business since 1898.



TOLL BOARD, LANSING (MICH.) EXCHANGE OF THE CITIZENS' TELEPHONE COMPANY.

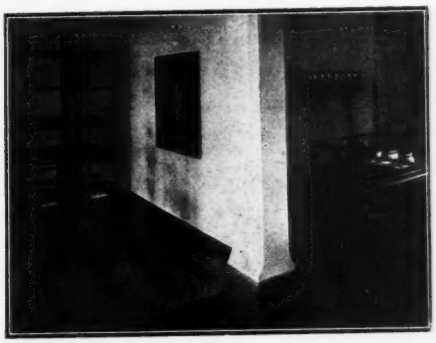
The company has been getting ready for the cut-over for the past two years. To do this necessitated the installing of new underground conduits and cables, taking down aerial wires and making other changes in its outside construction. The work on the new building was started last spring, and about five months ago rewiring of subscribers' premises, preparatory to the installation of the automatic telephones, was started. The first consignment of apparatus came in the early part of winter, and from that time till now the building has been alive with carpenters, decorators and electricians.



GENERAL VIEW OF AUTOMATIC EXCHANGE APPARATUS, CITIZENS' TELEPHONE COMPANY, LANSING, MICH.

Very little trouble was caused by the cut-over. For the first few days after it was made, the capacity of the exchange was overtaxed, as everybody with automatic telephones was trying to get everybody else similarly situated. It was too much of a novelty to be resisted, with the result that subscribers frequently got the busy signal. But it was not long before normal demands only were made on the plant, and the subscribers are loud in their praise of the new and better service. The installers have left their work, and only the officers of the company, including General Manager Tarte and Local Manager Hughes and their helpers, know what a task it is to cut over to a new exchange without demoralizing the service.

Lansing is now a city of about 35,000 population, the last 20,000 having been gained in the past eight years, during which the city has become a hustling place. At any rate, Mr. Tarte predicts that the 1,800 subscribers which the company now has will be increased to 3,000,



TOLL DISTRIBUTING FRAME AND HARMONIC CONVERTER.

and his predictions in the past as to his company's growth have had a way of coming true.

The first independent telephone company to serve Lansing was the old Citizens' Telephone Company of Lansing, which was established through the efforts of some of the local business men. The company did not make a great success of the new venture, however, and in 1898, by which time the Citizens' Company of Grand Rapids had expanded considerably, the Lansing concern sold out to the Grand Rapids company, the present owner. The company improved the service as much as it was possible to do with the equipment then in use, but shortly after the transfer, negotiations began to be made with the Common Council of Lansing for a new franchise, under which the company should agree to install automatic service and in other ways improve the service on being granted certain privileges, as to rates, etc. The agreement finally reached was this, that, in consideration of installing automatic service, the company was given a franchise, with the following schedule of rates agreed upon: Instead of the old rates of $18 for residence telephones and $24 for busi-

ness telephones, the new rate should be $20 for residence and $30 for business telephones, with a provision that those who signed contracts for four years could have the new telephones during that period for the old rate. As soon as the number of subscribers reaches 2,400, it is provided that the rates may be increased to $22 for residence telephones and $33 for business telephones, and to a maximum rate of $24 for residence telephones and $36 for business, when the number of subscribers reaches 3,200.

The new exchange, which is located in the block adjoining the state capitol lot, at No. 220 Capitol Avenue, is a model telephone building. It is built of reinforced concrete, faced with red brick, and is fireproof throughout. It consists of two stories and a nine-foot basement, which is mostly above ground. The basement contains the furnace, coal rooms and cable runways, but the greater part of it is used as a supply department for cables, heavy construction material, etc.

At the entrance of the building is the lobby or public waiting room. This room is furnished in golden oak, with tile floor, and is equipped with sound-proof booths for long-distance service. To the right is the office of Manager Hughes, and the balance of the south half of this floor is used by the cashier and bookkeepers. The north half of this floor is occupied by the toll-board.

Five operators are required to handle the toll business for the Lansing exchange, but provision is made for a larger number, as it is expected that a considerable increase in toll business will be secured in a short time, on account of the growth of the Home Telephone Company's exchange at Detroit, which now has 12,000 telephones, and the development in other points in Eastern Michigan by the Interstate Long-Distance Company of Detroit.

On the second floor is found the equipment for the automatic exchange. This equipment is all of the automatic type and was installed by the Automatic Electric Company, of Chcago.

All cables enter the building through a concrete tunnel twenty-five feet long, six feet high and four feet wide, extending from the building into the center of the street. The method of making the cut-over was as follows: Permanent cables were run from the distributing frame in the new building to several different manholes, about a block from the building, and were there bridged on to the old cables, and after the cut-over was made, the cables going up to the old office were cut off in the different manholes. In this way the change was made without cutting any of the lines out of service.

An American Electric Fuse Company's distributing board, with self-soldering coils, has been installed; its capacity is 1,800 lines, which can be increased at any time. On the line-cable side, there is a complete equipment for 2,000 lines. The terminals on the line side are in groups of twenty-five pairs, mounted 200 high, and on the central-office side in groups of 200 pairs, mounted 200 high.

After going through the distributing frame, lines are carried directly to the automatic switches. Instead of going to a first selector switch, they go to a Keith flat-type line switch. These are mounted in groups of 100.

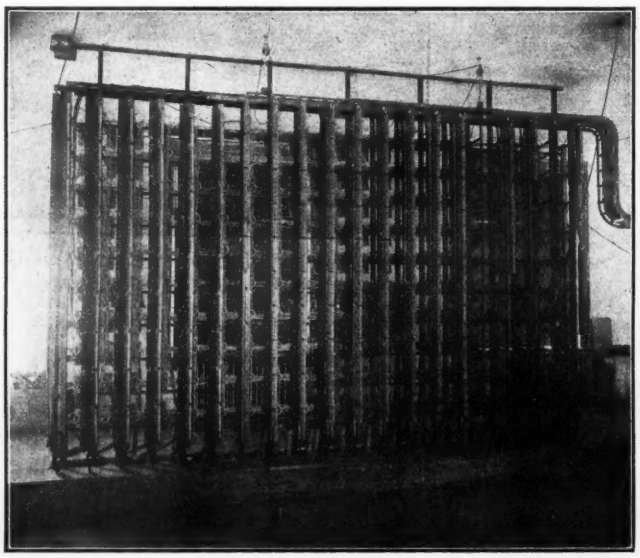
The automatic apparatus consists of a primary and secondary line switch, firsts, seconds and connectors. In making calls from 300 to 800 and 3,000 to 8,000, the primary and secondary line switches, first selectors and connectors are used. On all calls above this, the primary and secondary-line switch and first selector, second selector, and connector are used.

On each board is mounted a power panel, which has the generator, busy, main and ground batteries. No heat coils are used in the automatic switches. From each thousand section is a main-feeder terminal, which distributes the current to the different boards in that thousand.

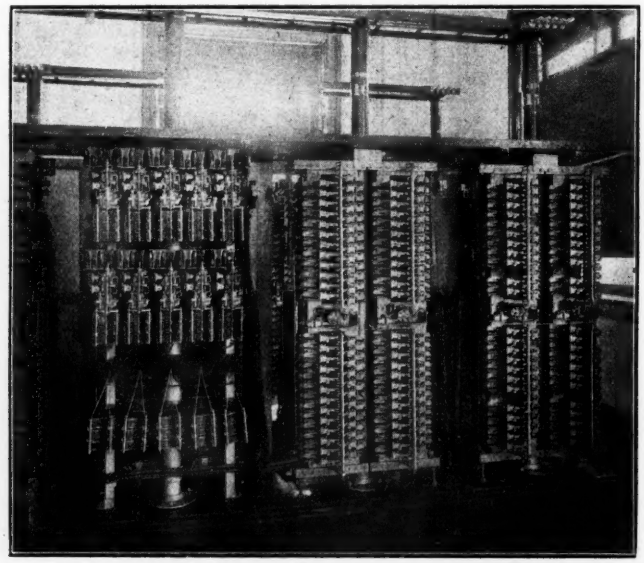
Instead of using ten trunks to ten first selectors on each board, the ten trunks are run through the secondary board, thereby reducing the trunks to first selectors. For one thousand subscribers, it would be necessary to use 100 first selectors, but by using the secondary board, the first selectors may be cut down to any number desired. In other words, the secondary board is a duplicate primary board, and works in the same manner.

In this exchange a central-energy, two-wire system is used, thereby doing away with the ground wire at the subscriber's station. The call is made in the same manner that it would be on a three-wire system, with the exception of pushing a button, which is done automatically through the connector.

The power apparatus includes a rectifier for charging storage batteries, which



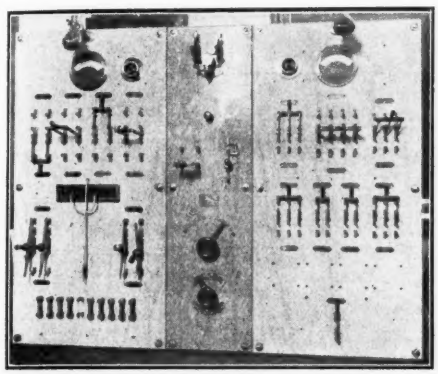
MAIN DISTRIBUTING FRAME.



PRIMARY LINE SWITCHBOARD.

is run from a 220-volt alternating current, and an Automatic Electric Company's harmonic ringer, which is run by the storage-battery current of forty-six volts.

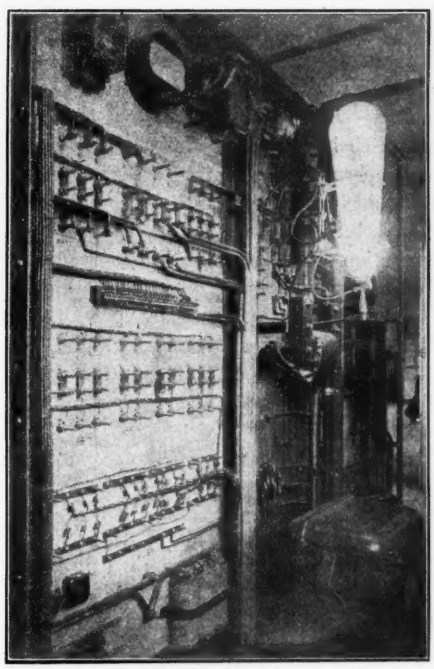
On the power board there is a high and low-voltage telltale, ammeter and volt-



FRONT OF POWER BOARD.

meter and underload and overload switches, a complete equipment for an automatic exchange. The storage-battery plant consists of two Gould storage batteries of twenty-four 150-ampere-hour cells each.

The toll-board is an eight-position



REAR OF POWER BOARD.

board, the first position being wire chief's test panel, the next two toll, one recording board, two more toll, and two rural boards. It is a multiple board, equipped with transfer trunks to the automatic switches and different boards.

The Citizens' Telephone Company was organized in Grand Rapids, Mich., September 13, 1895, with a capital stock of $100,000. Service was first given in its Grand Rapids exchange on July 1, 1896, with 832 telephones installed. The growth of the Grand Rapids exchange since then has been very rapid, and it now has 9,500 telephones in service. Outside exchanges have been built from time to time, others have been purchased, and the necessary toll lines to connect the different parts of the system have been constructed. The company now has eighty exchanges in operation, with 27,000 subscribers, 4,000 miles of metallic toll circuits, and has traffic arrangements with the other independent telephone companies in the state and neighboring states, so that first-class toll connections are made with 115,000 independent subscribers in lower Michigan, 328,000 in Ohio and 200,000 in Indiana.

The company is now capitalized for $2,000,000, and $1,400,000 has been paid in. It has now gross earnings of about seventeen per cent, and had paid dividends of eight per cent yearly since its organization. The officers of the company are Chas. F. Rood, president; Edward Fitzgerald, vice-president; Wm. J. Stuart, treasurer, E. B. Fisher, secretary; C. E. Tarte, general manager; Albert Stacey, superintendent of construction; and Harry H. Ide, superintendent of equipment. The last four gentlemen have active management of the system.

New York Rapid Transit Bills.

Assemblyman Robinson and Senator Travis have introduced bills into the New York Legislature amending the rapid-transit act as to New York city, drawn by the Public Service Commission and intended to carry out its recommendations as to the changes in the law. The bill is a part of the commission's recommendations that the constitution be amended so as to allow exemption from the city debt limit of self-sustaining rapid-transit roads, that the rapid-transit act be amended so as to make it possible for the commission to be freed from some of the restrictions now existing in that act, and that some method of constructing the rapid-transit lines in outlying boroughs be provided whereby at least a portion of the cost can be paid for by local assessments. The bill amends the rapid-transit act and provides for construction by assessment. The constitutional amendment passed the Legislature last year and has been reported in the Senate this year.

As to the assessment plan, the bill has a provision making it possibile to assess all or part of the cost of a rapid-transit line upon the area benefited. The bill provides that rapid-transit lines may be built either with city money or with private money, with title to the road either in the city or in the company. In the latter case the property will be subject to taxation. The bill contemplates the granting of a franchise for a fixed period with a provision that the city may, at any time after ten years, become absolute owner by making payment for the property taken without any payment for the franchise. If the city does not buy the property after ten years and before the expiration of the period fixed in the contract, the railroad must become the property of the city free and clear at the end of the period fixed and without any payment by the city. While the railroad remains in the hands of the company net profits must be divided equally between the company and the city.

The present operating term of twenty years, with provision for an extension of twenty years more, is retained, as it is considered that occasion may arise where this method and term are suitable. An alternative is provided that independent rapid-transit railroads may be constructed with city money, as now, by the lowest bidder for construction. The city may then contract with private parties to equip and operate, but any such contract after ten years is subject to termination at any time by the city on making payment therefor in the manner fixed by the contract, and after a definite period, to be fixed in the contract, the right of operation shall cease. The city must buy the equipment at appraisal price on its termination. It is also provided that net profits shall be divided, share and share alike, between the operator and the city.

A further provision allows the commission to take advantage of the method outlined in some of the recent offers that have been made for the construction and equipment, title of the railroad, however, to be in the city at all times. Amendments also allow the construction, ownership and operation by private parties of extensions of existing subways or elevated railroads, but such extensions must be subject to purchase by the city at any time after ten years and must become the property of the city after a lapse of a suitable period for amortization without payment by the city.

THE ELECTRIC VEHICLE MOTOR.

BY J. T. DEREMER.[2]

The motor equipment of an electric vehicle consists of the following:

(1) One or two motors, according to the requirements of the vehicle.

(2) The controller complete with cable tips.

(3) The main switch with cable terminals.

(4) The charging receptacle with plug and cable.

(5) The battery contacts with cable terminals.

(6) The wire and necessary wiring diagrams.

With these parts properly selected, anyone familar with ordinary vehicle construction can build electric vehicles also.

Of these parts we shall here consider only the motor, its controller and their connection to each other.

Let us first look into the advantage inherent in an electric motor for this use. The electric vehicle is not in its present stage of development adaptable to all purposes for which other types of cars have proven so successful, but in its own particular field of operation, namely, the city-suburban duty, it has advantages over all others, and of these advantages the following stand out conspicuously as due to the motor.

Its operation is noiseless, due to the absence of reciprocating parts; it is free from vibration; it is cleanly and free from odor; it is very simple in construction and suspension, thus permitting of easy and rapid repairs or replacement, and its maintenance and upkeep are comparatively negligible.

Before going into an analytical study of the motor, let us for a moment look into the requirements of a vehicle motor.

The motor best suited to this service combines those features which will give sufficient strength, together with the best average speed, efficiency and high torque values in proportion to the current consumed. Unlike motors for all other classes of work, it can have no protective devices, such as circuit-breakers, or wires that will fuse and open the circuit when an excess of current passes. Such protection is impracticable, because when an excessive demand for power is made by the motor of an electric vehicle it is at a critical point in its operation, as on a heavy grade, a bad place to start, or a condition when above all other times power is wanted most and must be relied upon. The motor, therefore, must be designed and constructed to withstand all the power that can be applied to it in the propulsion of the vehicle for which it is built. Further, automobiles are frequently driven by persons who have but little idea of what a machine should be able to stand, and who, therefore, use poor judgment in operating them. Motors which cannot undergo the abuses of such service without injury are not practicable. In still another respect an automobile motor must possess exceptional qualities—it must combine strength and lightness so as to insure good operation amid all the jolting and vibration of travel, with the fewest possible repairs. A properly designed motor, for use in connection with storage batteries, must possess a well-sustained efficiency curve at overloads, and still retain its good speed and torque characteristics throughout its range of operation. The amount of iron and copper used must not be stinted; although generous proportions in this respect may add somewhat to the weight of the motor, this increase is more than counterbalanced by the resulting improvement in its operating characteristics.

Let us now look briefly into the construction of the motor to see how the above requirements have been fulfilled.

The motor is built for two sets of speeds—the high-speed motor for operation with a double-reduction gear and the low-speed motor with a single-reduction gear. Where large output together with light weight are the essential requirements, the light-weight high-speed motor with the double-reduction gear is preferable. On the other hand, where a greater weight is permissible and long life of wearing parts is a feature, the heavier weight low-speed motor with the single-reduction gear should be used.

We shall treat the construction of the motor under two heads:

THE MECHANICAL CONSTRUCTION.

The frame of the motor is built in cylindrical form. This is in order to get the greatest output from the least quantity of material. The frame is entirely enclosed and solid, that is, made in one piece. The armature is removed by taking off one of the end brackets. The motor is made waterproof, which is a valuable feature when the madam's garden hose is turned on the machine to remove the mud accumulated during the recent rain. The armature and commutator of the motor are built up on one sleeve, and the shaft pressed into this sleeve, so that if the shaft of the motor becomes sprung through careless operation or very rough usage, it can be readily removed and another put in.

The oiling system is the same as is employed in street-railway motors, that is, the well-known type of wiper or waste-packed bearings. The motor is suspended by four stud bolts at each end and is thus easily removable for replacement or repairs when necessary.

THE ELECTRICAL FEATURES.

The automobile motor is of the direct-current, series type, and has operating characteristics similar to the street-car motor. Other types have been tried, such as compound-wound motors and also shunt-wound motors, but none of these possess in the same degree the valuable characteristic of automatically adjusting the consumption of power, as it were, to the load; that is, as the load increases the speed decreases, thus lengthening the time of operation, and hence decreasing the power necessary to produce a definite torque. The efficiency of the motor is maintained fairly high throughout its range of operation.

Just here let me call your attention to a feature especially characteristic of the electric motor as compared with other forms of vehicle motors.

As is well known, a railway-type motor is rated intermittently, that is, the nominal capacity of the motor is that capacity at which it can operate for one hour with a temperature rise not to exceed a given amount. This method of rating has been found best adapted to work such as the operation of street-railway cars requires, because on an average city line the motor is working only a few moments at a time, due to the many stops and inclines, and hence has an opportunity to cool down during the intervals when current is not applied.

Obviously, a motor suitable for continuous operation, developing the same horsepower as a regular street-car motor operating intermittently, would have to be very much more liberally rated in order that the heat generated internally could be radiated sufficiently fast to prevent an injurious rise of temperature.

Now the same principles apply to automobile operation, that is, a motor in city truck service as well as pleasure vehicle operation, is subject to only intermittent operation, and consequently the motor can be rated much more closely than could a motor for continuous operation.

It has been found that for continuous operation the demand on the motor must

1. Paper read at first annual convention Pacific Coast Electric Vehicle Association.
2. Westinghouse Electric and Mfg. Co., San Francisco.

not exceed sixty per cent of the one-hour rating. The point I wish to emphasize in this connection is as follows:

By reference to the performance curves of the series automobile motor it is found that the efficiency of the motor is highest when operating at approximately sixty per cent of the nominal rating. Hence, if continuous operation is necessary, the maximum permissible output which can be taken from the motor will be obtained with the motor operating at its highest efficiency.

THE CONTROLLER.

Let us now take up the controller and its connection to the motor in order that we may ultimately bring out other points of advantage in the complete electric equipment.

The controllers for vehicle motors are made in such a form that they may be set in the seat of the vehicle where they are easily accessible from the top and the front. The controller is of the familiar drum type, with sliding contacts and fingers which press against the contacts. The reverse drum is a part of the controller and is operated by the main control lever, or by a heel press at the bottom of the vehicle. The main drum and the reverse drum are made interlocking, so that it is impossible to reverse the motor with the controller handle in any but the off position. In this position the main drum is locked unless the reverse drum is exactly in the forward or reverse position.

The operation of the controller serves to apply several successive electromotive forces to the brushes of the armature and hence vary the speeds accordingly.

The method of control differs somewhat from that employed in street-car service. in that no resistance is employed for controlling the voltage applied to the motors. The interconnecting of batteries and field coils and motors is so arranged that four speeds forward and from one to four speeds reversed operation are obtainable.

This type for control for automobiles is of two kinds. The first is that in which the battery connections are changed as well as those of the motors. This plan is employed usually where only one motor is used, or where it is essential to make the work required of the battery as easy as possible. The second type of control changes only the motor connections, the battery cells always remaining in series. This plan is employed where two motors are used, as it is here possible to obtain a greater number of combinations than in the case of a one-motor equipment.

If you will bear in mind that the fields of each motor are separated into two equal groups, and that the battery is arranged into two equal groups of cells, the following brief statements of the motor control will be easily understood:

First Notch.—Field groups in series; battery groups in parallel. (This applies the lowest obtainable electromotive force to the brushes.)

Second Notch.—Field groups in parallel; battery groups in parallel. (This applies a higher electromotive force to the brushes, because the total voltage drop across the field is reduced.)

Third Notch.—Field groups in series; battery groups in series. (This applies a still higher electromotive force to the brushes.)

Fourth Notch.—Field groups in parallel; battery groups in series. (This impresses the highest obtainable electromotive force upon the brushes.)

In the two-motor equipment the fields as before are in two groups, but the battery is always in one group. The connections are made here as follows:

First Notch.—Field groups in series; armatures in series.

Second Notch.—Field groups in parallel; armatures in series.

Third Notch.—Field groups in series; armatures in parallel.

Fourth Notch.—Field groups in parallel; armatures in parallel.

You will note in the above description of speed control, which possibly sounds somewhat complicated, and yet in reality is extremely simple, that there is an entire absence of mechanical complications such as is necessary in other types of cars, the motor being in every instance connected rigidly to the driving wheels and the entire control of the machine reduced to the simple electrical control of the motor. This fact brings to mind two very important advantages of the electrically driven machine; namely, in addition to the regular band-brake equipment of the automobile an emergency brake can be arranged on the end of the motor shaft, and since the motor is always in direct communication with the driving wheels, this will prove an additional factor of safety. There is further a possibility of using the electric motor as a generator for braking purposes, thus eliminating brake friction and the strains incident to brake application. The motor is turned into a brake or generator by simply reversing its armature connections and connecting the armature leads across a resistance.

The above plan, however, is very sensitive to the speed at which the car is moving at the time the application is made, being very light at low speed and very heavy and effective at high speed. The better plan is to place the fields in series with each other and with a small hand-operated resistance across a few cells of the battery. Then by closing the armature circuit the amount of braking effect can be regulated by the resistance handle, and the braking as in the case of a long hill made as effective as desired.

It is almost superfluous to add that the up-keep of the electric motor and controller is scarcely to be considered seriously. Of course the bearings and brushes need occasional looking after, but as in street-car service the brushes frequently run for months without renewal and bearings only need their proper supply of oil. The attention given any ordinary machine will, of course, keep the bolts tight and the lids and the hand-holes covered, which is more vital in the case of the motor, owing to the necessity of excluding moisture.

Summing up the situation then—as a power, the electric motor is incontestably a most suitable medium for automobile work, by reason of its being practically perfectly safe, its capacity for direct application, its high ratio of efficiency and the facility by which it can be controlled. Not only does the electric motor automatically control the consumption of energy, both with light and heavy loads, in proportion to the power delivered, but it will also work should occasion arise with an overload of several hundred per cent for brief periods of time without any appreciable inconvenience.

Exide Meeting in Cleveland.

An Exide meeting was held under the auspices of the Electric Storage Battery Company in the assembly hall of the Case School of Applied Science, Cleveland, Ohio, on March 29. The lecture of the evening was delivered by H. M. Beck, engineer of the operating department of the Electric Storage Battery Company's Chicago office.

This lecture gave in detail the development of the "Exide" battery up to its present state, and after the lecture there was a general discussion of the subject which brought out a great deal of valuable information in relation to the care and operation of the Exide battery. Various parts of these batteries were on exhibition for the inspection of the guests. There was a very large attendance, about 250 being present.

THE INDUSTRIAL APPLICATION OF THE ELECTRIC MOTOR IN STEEL MILLS.[1]

BY B. R. SHOVER.

III.

(Concluded.)

Table and Transfer Motors.—In the rolling mill proper there are twenty-one tables and two transfers, all of which are controlled by automatic magnetic torque-limiting control.

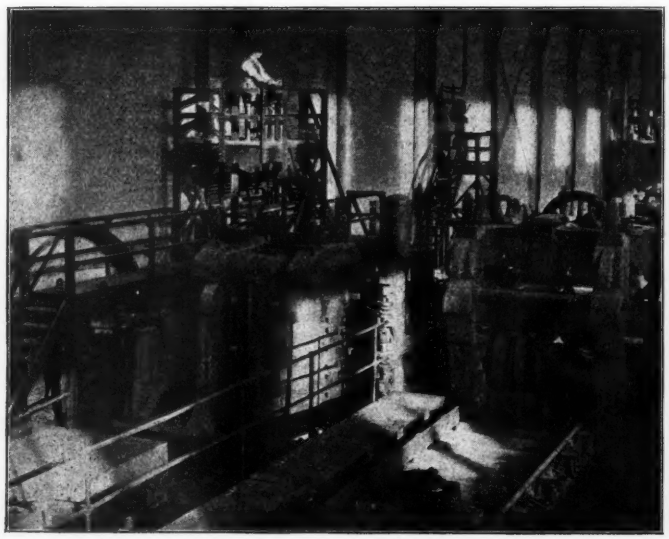


FIG. 10.—CONTROL PULPITS FOR RAIL MILL.

The eight operators stand on elevated platforms or pulpits, Fig. 10. Some of the controllers are mounted on the operating pulpits and others on special platforms located near the motors which they control.

These tables and transfer motors are all of the so-called mill type. Tables running constantly are equipped with series-shunt motors. Those doing a considerable amount of reversing or frequent starting and stopping have series-wound motors. Fig. 11 gives the ampere chart of one of these tables.

The transfers are simple chain drive, having two sets of dogs for moving the rail sidewise, and the control is entirely automatic. When the operator throws his controller to the forward position the transfer chain makes one-half revolution, depositing the rail in the proper place. Then the motor stops automatically. The next motion for transferring the following rail is made by the operator putting his controller to the "off" position and again throwing it to the "on" position. An interesting feature of the auxiliary drive is that of the lifting table at the three-high forty-inch blooming mill, Figs. 12 and 13.

This table has a total weight of 256,000 pounds, partly counterbalanced by means of a cylinder containing air at 500 pounds per square-inch pressure, and is lifted or lowered forty inches in three seconds. The operating motor is 250-horsepower, 250-volt, direct-current, compound wound. The control, like that of the table motors, is entirely automatic, and is manipulated by the operator simply throwing his master controller to the up or down position, the accelerating, running, retarding and stopping being taken care of automatically.

There is also a tilting table at the three-high roughing rolls, similar to the lifting table, but of considerably less weight. This table gives one complete stroke of twenty-six inches either up or down, in 1.5 seconds. It is driven by a 150 - horsepower, 250 - volt, compound-wound motor, and is controlled like the lifting table.

The hot saws, Fig. 15, five in number, are driven individually by forty-horsepower, 750 revolutions-per-minute induction motors. The saws are forty inches in diameter and make 1,440 revolutions per minute. All five are raised and lowered at one time by a crank-shaft, operated by a twenty-five - horsepower compound-wound mill-type motor. The control is similar to that of the lifting table, except that if the operator throws his control to the first point, the saws lower and stop in that position. It is then necessary for him to bring his control to the first point on the reverse in order to raise the saws; then the latter come up to the top and again stop automatically. In regular operation, however, the operator throws to the second point;

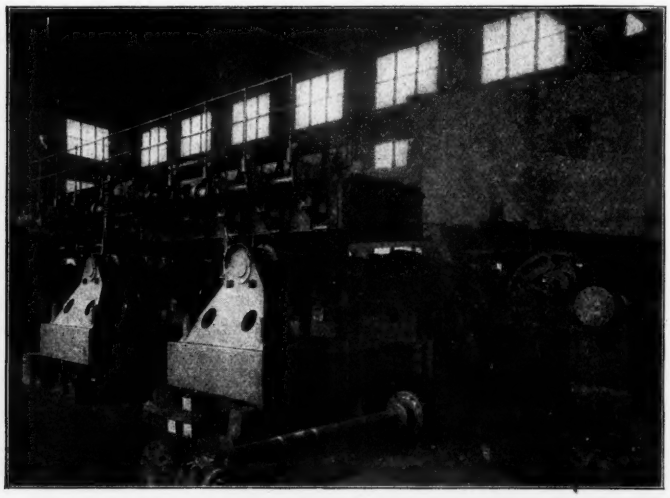


FIG. 12.—LIFTING TABLE FOR 40-INCH BLOOMING MILL.

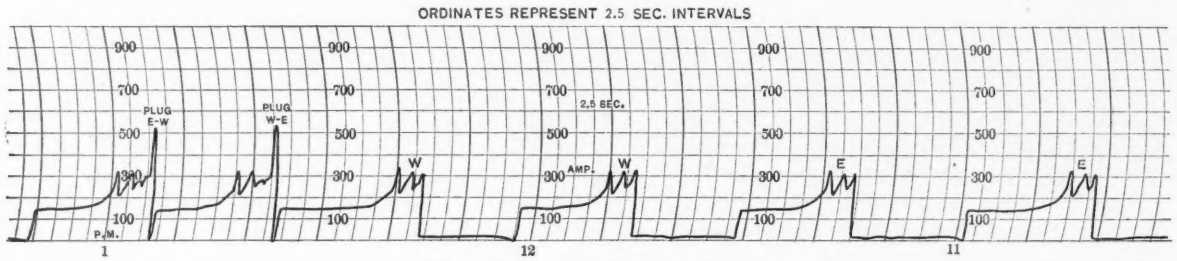


FIG. 11.—CURRENT VARIATION ON TWO 25-HORSEPOWER MOTORS RUNNING ON SAME SHAFT AND DRIVING A MILL TABLE.

1. Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, March 12, 1909. The full title of the paper is "The Industrial Application of the Electric Motor, as Illustrated in the Gary Plant of the Indiana Steel Company." The author is electrical engineer of that company.

upon which the saws lower, cut the rail and again rise, stopping automatically in the upper position.

The cambering machine is driven by a forty-horsepower induction motor. On the hot beds, four in number, there is a push-up for shoving the rails off the delivery table on to the beds, and a pull-up for dragging the rails from the beds on to the receiving table in the finishing mill. These "push-ups" and "pull-ups" are driven by seventy-five-horsepower series mill-type motors, the controllers of which are also automatic.

From the receiving table the rails are delivered in both directions to the finishing department by feed tables similar to those in the rail mill. Because of the continuous running of these feed tables the controllers are the ordinary hand-operated type.

For delivering the rails from this table to the straightening beds "kick-offs" are used. These are simply bars lying normally below the surface of the table, but raised at an angle so that the rails are lifted and then slid off by means of a cam on a motor-operated shaft. The straightening presses, Fig. 18, eighteen in number, are driven by ten-horsepower high-resistance rotor induction motors. Opposite the ends of the straightening beds for each straightening press is located a twenty-four-inch headlight, in which is used an ordinary sixteen-candlepower lamp to enable the straightener to see his rail clearly. The drill presses, eighteen in number, are driven by ten-horsepower induction motors with ordinary squirrel-cage rotors.

All of the induction motors in the finishing department are standard and are controlled by means of a triple-pole, double-throw switch, which is connected to a five-wire system. The two extra wires are taps taken off the main transformers, thus furnishing low voltage for starting. This system does away entirely with the complication and trouble accompanying individual starting compensators.

The loading beds outside are covered by two special electric cranes which transfer the rails from one part to the other, or load them in cars, the rails being handled by means of large special magnets. On the south side of the runway of these cranes is also a small monorail crane, whose sole purpose is to deliver rails to the cold-saw bed.

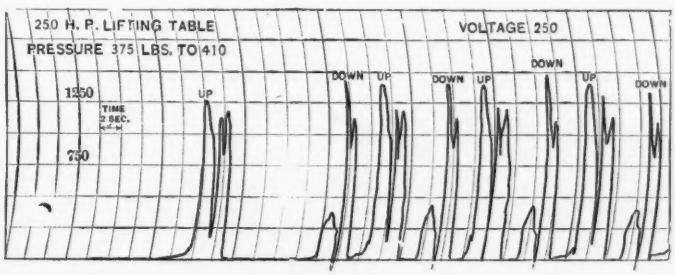


FIG. 14.—CHART SHOWING LOAD ON LIFTING TABLE.

The cold saw, a tooth saw forty-two inches in diameter, making 1,800 revolutions per minute, is driven by a 100-horsepower induction motor. This saw is capable of cutting through an eighty-five-pound rail in twenty-two seconds, the load varying between fifty and 100 horsepower, according to the part of the rail that is being cut.

Motors for Driving the Rolls.—As outlined earlier in the paper, although electric motors have been used for some time to drive rolls, the motors used in this plant are several times larger than any motors of their type previously built. Their use for this purpose marks a new era in the industrial application of electric power, and a short description of some of the principal features in the design of these motors is not out of place.

The main rolls of the mill are driven by six induction motors having a combined capacity of 24,000 horsepower, made up of the following units:

Two 2,000-horsepower, at 214 revolutions per minute.
One 2,000-horsepower, at 68 revolutions per minute.
One 6,000-horsepower, at 88 revolutions per minute.
One 6,000-horsepower, at 83 revolutions per minute.
One 6,000-horsepower, at 75 revolutions per minute.

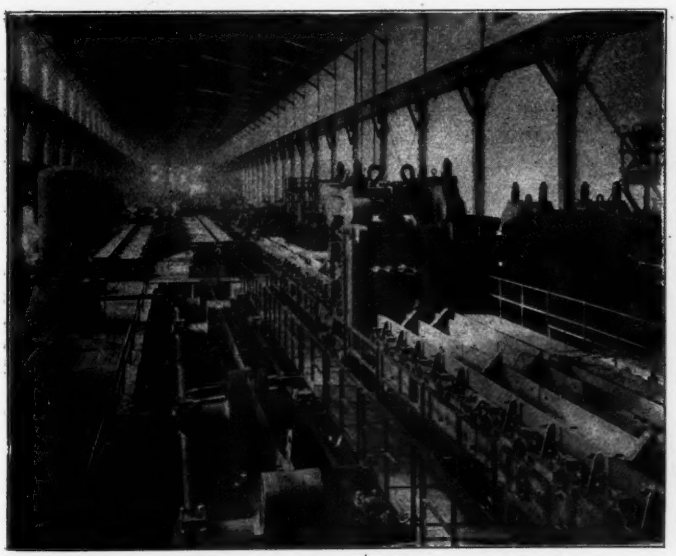


FIG. 13.—LIFTING TABLE FOR 40-INCH BLOOMING MILL.

FIG. 15.—THE HOT SAWS.

In the construction of these motors the parts were made extremely heavy and rigid, following out as far as possible the practice which has proved successful in the construction of steam engines for similar duty. The stator frame is of the box-type construction, and is split into four sections for ease in handling and transportation. The rotor spider is of cast-steel and is made up of four sections

with two arms per section. The sections are bolted to disc hubs, which are pressed on the shaft.

As the flywheel effect of the rotors necessary to overcome the excessive loads in rolling can only be determined accurately by actual trial, it was deemed advisable where possible to construct the motors so that the flywheel effect could be altered after the motors had been put in operation. This was accomplished in the 6,000-horsepower and the 2,000-horsepower motors that run at sixty-eight revolutions per minute, by attaching to the rotor spiders heavy cast-steel rims which could easily be removed and exchanged for rims of different weights. On account of their triple speed, the two 2,000-horsepower, 214 - revolutions - per-minute motors have separate flywheels weighing 100,000 pounds each. These flywheels are built up of riveted boiler plates, which do not permit of alteration.

The end-thrust which may result from a diagonal fracture of a spindle or roll is frequently sufficient to wreck either the mill or the motor unless special precautions are taken. This problem, which is extremely difficult to solve when an engine is used for driving the rolls, is very easily solved when electric motors are used. A device termed a mechanical fuse is attached to the pedestal by two breakable rods. These rods are so proportional that they will break only when the end-thrust exceeds 150 tons. When the rods give way under this pressure, the rotor is free to move longitudinally away from the rolls, thereby relieving the thrust. To prevent injury to the brush rigging, it is so arranged as to move freely with the brushes, always maintaining their proper position on the collector rings.

The bearings are self-aligning, with oil-ring lubrication. They can also be lubricated from an independent oiling system. Provision is made for water cooling in case of emergency.

The coils, which are assembled in open slots, are very rigid. In order, however, to prevent any possible vibration due to excessive fluctuations of the current, the coils are also firmly laced to a rigid supporting ring.

The electrical characteristics of the larger motors are shown by Fig. 16, which represents the results of tests of the 6,000-horsepower motor at eighty-eight revolutions per minute. Reference to these curves shows that the power-factor and efficiency are near their maximum at the rated output of the motors, and that high values are maintained throughout the complete operating range.

The two 2,000-horsepower, 214-revolutions-per-minute motors were received at the Gary works complete except the flywheels, which were built up and turned after the installation of the motors. The three 6,000-horsepower and one 2,000-horsepower, low-speed motors were assembled and wound in position.

Only two minor troubles have developed so far in the entire installation. On starting up one of the 6,000-horsepower motors, one section of the rotor resistance overheated, but investigation proved this trouble to be due to a stray piece of arc-lamp carbon. In starting up another of these motors, trouble developed due to a broken grid in the rotor resistance.

DATA OF ROLL-DRIVING MOTORS.

Horsepower:					
Normal continuous rating 40° rise	2,000	2,000	6,000	6,000	6,000
25% overload continuous 50° cent. rise	2,500	2,500	7,500	7,500	7,500
50% overload for 1 hour 60° cent. rise	3,000	3,000	9,000	9,000	9,000
Speed:					
Synchronous	214	68	83.3	88	75
Full load					
Maximum slip, per cent.					
Performance specification number					
Outline drawing number					
Bearings:					
Flywheel Side.					
Diameter	24	26	30	30	30
Length	60	65	70	70	70
Collector Side.					
Diameter	24	26	30	30	30
Length	60	65	70	70	70
Thrust collar area	575	910	1,370	1,370	1,370
Revolving Part of Motor:					
Diameter	8 ft. 8 in.	21 ft. 0 in.	21 ft. 0 in.	21 ft. 0 in.	21 ft. 0 in.
Flywheel effect, lb. at 1-ft. radius	354,000	8,950,000	11,600,000	11,600,000	14,100,000
Stationary Part of Motor:					
Outside diameter of frame	13 ft. 4 in.	28 ft. 0 in.	28 ft. 0 in.	28 ft. 0 in.	28 ft. 0 in.
Width of frame	3 ft. 10 in.	3 ft. 8 in.	4 ft. 11 in.	4 ft. 11 in.	4 ft. 11 in.
Air-gap, total	0.28	0.40	0.40	0.40	0.40
Induction Motor:					
Poles	14	36	44	34	40
Horsepower	2,000	2,000	6,000	6,000	6,000
Revolutions per minute	214	68	83	88	75
Volts	6,600	6,600	6,600	6,600	6,600
Efficiency at full load	95 per cent	93 per cent	95.5 per cent	95.5 per cent	95.5 per cent
Power-factor at full load	89 per cent	80 per cent	87 per cent	88 per cent	88 per cent
Breakdown torque	6,800 h. p.	5,100 h. p.	18,500 h. p.	20,600 h. p.	16,400 h. p.
Flywheel:					
Material	Laminated steel		.....	.....	.....
Number of sections					
Diameter	17 ft.	.....	.....	.....	.....
Outline Dimensions:					
Height of machine above bottom of base	12 ft. 2 in.	21 ft. 0 in.	21 ft. 0 in.	21 ft. 0 in.	21 ft. 0 in.
Width of bed plate	20 ft. 4 in.	32 ft. 8 in.	32 ft. 8 in.	32 ft. 8 in.	32 ft. 8 in.
Length of bed plate	20 ft. 2 in.	18 ft. 11½ in.	21 ft. 9 in.	21 ft. 9 in.	21 ft. 9 in.
Total length of shaft	22 ft. 4¾ in.	21 ft. 3¾ in.	24 ft. 6¾ in.	24 ft. 6¾ in.	24 ft. 6¾ in.
Center line of shaft to bottom of base	5 ft. 6 in.	7 ft. 0 in.	7 ft. 0 in.	7 ft. 0 in.	7 ft. 0 in.
Weights:					
Stationary part of motor	42,500	126,000	175,000	175,000	175,000
Rotating part of motor without shaft	30,800	148,000	176,000	176,000	209,000
Shaft (hollow)	33,400	34,300	50,000	50,000	50,000
Pillow-blocks with bearings	72,300	105,500	138,000	138,000	138,000
Bed plate	100,000	150,000	185,500	185,500	185,500
Flywheel	100,000	.....	.....	.....	.....
Total.					
Without flywheel	296,000	.....	.....	.....	.....
Complete	396,000	578,000	749,000	749,000	783,000

Control for Roll-train Motors.—In designing the equipment for these 6,600-volt induction motors, not only were the sizes of the motors to be controlled beyond anything previously attempted, but the specifications presented many novel features.

For most of the motors the service required a very large flywheel effect. Because of the well-known characteristics of the induction motor, it was clearly recognized that there would necessarily be large fluctuations in current, even though the flywheels were very large, unless some means were employed for automatically introducing resistance into the motor circuit whenever the load was sufficient to cause even as small a change of speed as two or three per cent. It was desirable that the automatic features be adjusted so as to operate continuously, regulating the current taken by the motors, so that the demands on the source of supply for any one motor would be uniform—the motor and its flywheel, meanwhile, accelerating and decelerating at a point just below synchronism, to meet the power demands of the rail mill which it was driving.

The large current in the secondary circuits of the motors necessitated separate contactors. Rheostats were arranged in multiple delta, and the successive value of the resistance was made such that as each contactor closed, the rush of current through it would be approximately one-fourth of the intake of the motor. This arrangement prevents the rheostats or

contactors being called upon to carry anywhere near their full rated current, and gives the whole control system a conservative continuous rating.

The control apparatus for each motor consists of:

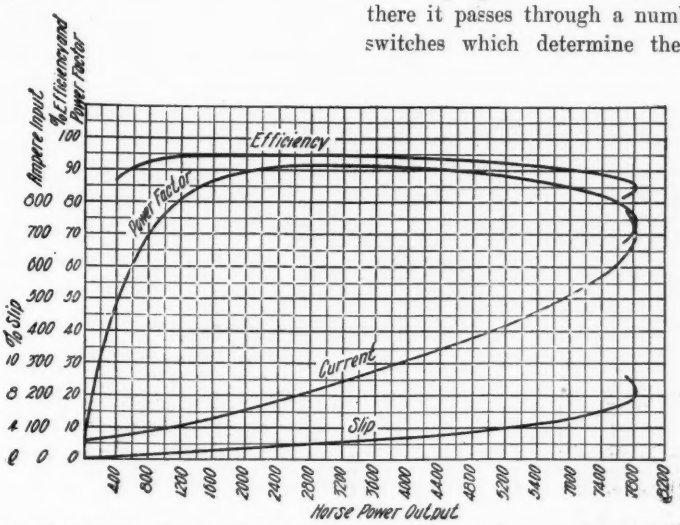


FIG. 16.—CHARACTERISTIC CURVES OF 6,000-HORSEPOWER INDUCTION MOTOR.

A. Preliminary - control apparatus, which includes the oil switches, reversing switches, series transformers, preliminary relays, etc.

B. Secondary control, comprising the rheostats, contactors, regulating panel, etc.

C. Master controller.

The plan of the plant shows that the motors and the controlling apparatus are placed in a separate room, which is separated from the rolling mill proper by a partition. The master controller, however, is in the rolling mill. Under these conditions, therefore, the operator must depend chiefly on the automatic features of the control, which are so far away that he must judge of their correct working by the behavior of the rolls while the steel is passing through them. In case of emergency provision is made for the motor attendant to shut down the motors independently of the master controller.

The 6,600-volt circuit enters through the triple-pole main oil-switch; from there it passes through a number of oil-switches which determine the direction of rotation. These switches are interlocked, making it impossible for them to be operated unless the main switch is open. Additional interlocks prevent them from being closed simultaneously. This group of preliminary-control apparatus also includes the necessary relays to open the circuit in case of overload and to prevent the secondary control from being operated in an injurious manner.

The arrangement of the secondary-control rheostats in multiple delta is shown in Figs. 19 and 20. Direct current at 250 volts was adopted, for the control of this secondary apparatus, and the voltages so arranged that each contactor coil is subjected to a pressure of only about fifteen volts. This pressure is so small that the arcing is insignificant. To compensate for the different number of contactors in circuit at different speeds, a balancing resistance equaling the resistance of the contactor is cut in or out of circuit inversely as the contactor. This keeps the current in the contactor circuit approximately constant at about five amperes, and results in a simple arrangement of contacts on the regulating device.

The regulating device consists of two concentric groups of buttons, one connected to the contactor coils and the other group to the contactor resistances, the two groups being cross-connected, step by step, by a simple arm, controlled automatically. Should the 250-volt supply fail, a weight attached to the grooved pulley on this arm serves to return the mechanism to the off position.

The Rail Mill.—The rail mill has a capacity of 4,000 tons of finished rails per twenty-four hours. It is not only the largest, but also the only motor-driven, mill in the world rolling rails directly from the ingot without reheating.

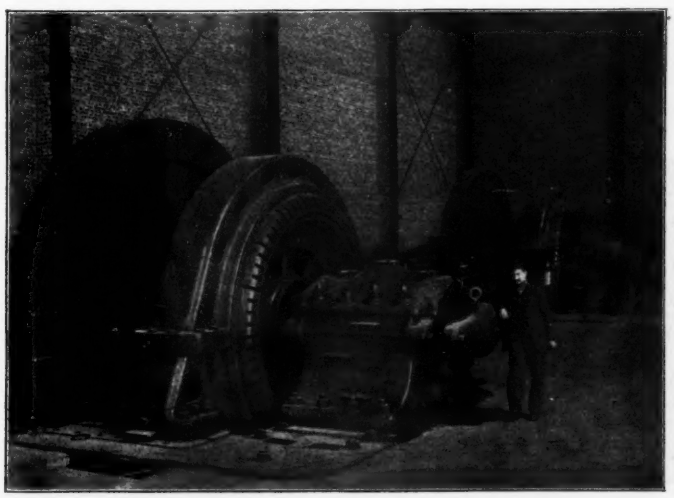


FIG. 17.—VIEW OF 2,000-HORSEPOWER INDUCTION MOTOR.

FIG. 18.—VIEW OF 6,000-HORSEPOWER INDUCTION MOTOR.

Diagrams of these passes, together with the approximate shapes of the pieces leaving them, are shown in Figs. 21 and 22, on which is also shown the table giving the size of the pieces leaving the various passes, the area in square inches, the weight per linear foot, percentage of reduction, length of piece, and horsepower

per pass—all as observed in the rolling of the first rail, which was an eighty-pound, thirty-three-foot rail.

To supply power to the train motors of this mill there are two circuits, each of 10,000 kilowatts normal capacity at 6,600 volts. One circuit feeds the three blooming-mill motors; that is, two 2,000-horsepower and one 6,000-horsepower. The other circuit feeds the other three motors; that is, two 6,000-horsepower and one 2,000-horsepower.

of ingots was increased to the maximum load on the mill. Adding the ordinates under this condition, Fig. 23 was produced, showing the integrated load carried by the motors. The shaded portion indicates motor and line losses, and the upper line of the curve shows the character of the load on the power station.

This cycle, which is 31.89 seconds, indicates an exceedingly variable load, the

per, which has been tried out, has been practically a perfect success. Nothing has occurred to indicate that there is any necessity of changing anything to a radical extent. As an example of this, the ore-handling machinery was started up July 23, 1908, and by November 1, three-quarters of a million tons of ore were stored in the yard, with virtually no more trouble from the machinery than would

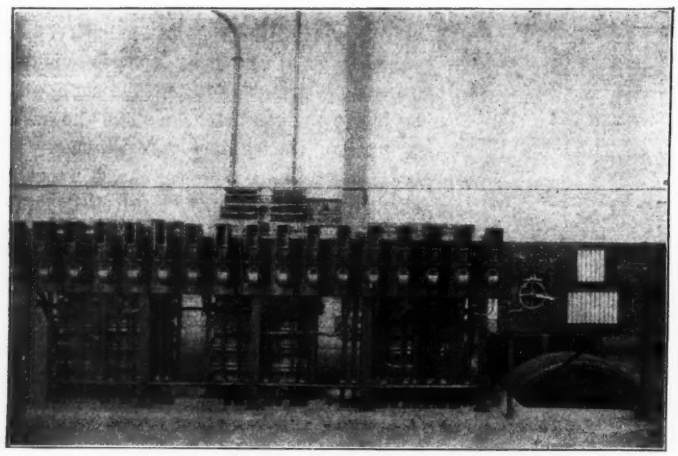


FIG. 19.—VIEW OF SECONDARY CONTROL FOR 6,000-HORSEPOWER MOTOR.

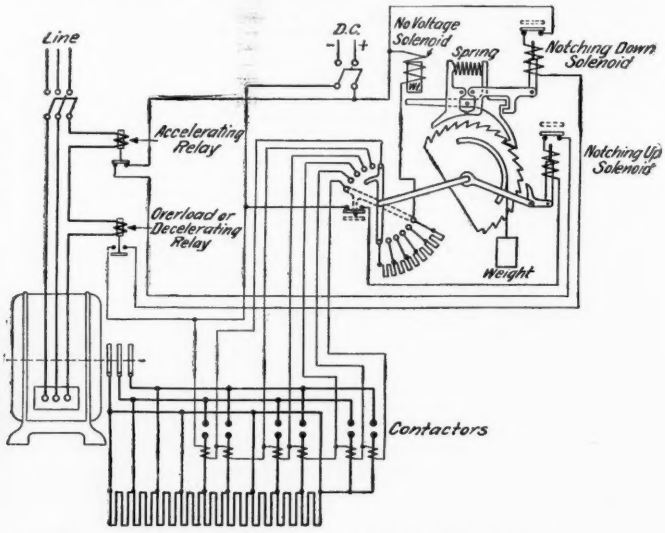


FIG. 20.—CONNECTIONS OF SECONDARY CONTROL.

The estimated combined load with the mill working at full capacity, with voltage and amperage of each of the circuits, is shown in Fig. 23. In originally designing the mill careful calculations were made of the time and horsepower required

total variations being from a minimum of 4,300 horsepower to a maximum of 19,010 horsepower, with an average of 12,025 horsepower, which makes the load factor on the six-train motors almost exactly fifty per cent. The curve was de-

have been experienced at a works which had been in operation for several years.

In the original design of the plant considerable attention was given to the question of underground versus overhead transmission. In view of later develop-

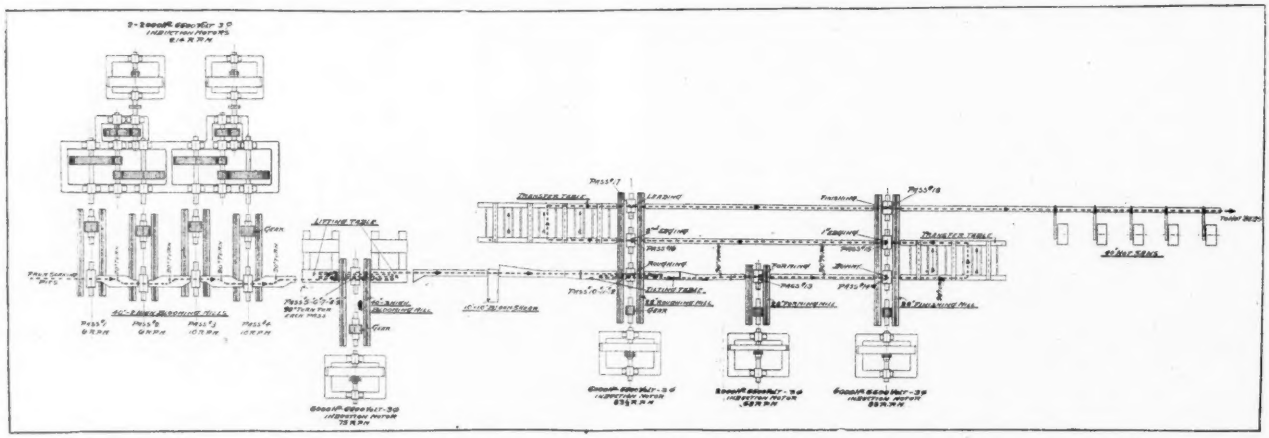


FIG. 21.—PLAN OF THE RAIL MILL.

to operate each pass. These calculations determined not only the total time consumed by the ingot from start to finish, but also the shortest possible time between ingots, the limiting time being in the three-high roughing mill.

These curves thus obtained were superimposed on each other at this interval, which was 31.89 seconds, until the number

veloped to provide a basis for estimating the size of the storage battery necessary to take care of the fluctuations and keep a constant load on the generating station.

Conclusions.—One of the most satisfactory conclusions, so far as the Indiana Steel Company is concerned, that can be drawn at the present date is that so far all of the apparatus described in this pa-

ments, although it might have been possible to put in underground service which would not have greatly exceeded the cost of overhead construction, yet the latter has given no trouble. On the night of January 29 last, during one of the severest windstorms ever experienced in this section, the velocity of the wind being estimated at over seventy miles per

nour, not a single case of trouble occurred on the lines within the plant.

As stated in the description, all of the 6,600-volt feeders were protected by multi-gap lightning arresters, while the 22,000-volt line has both multi-gap and electrolytic lightning arresters. The latter were not installed until after the former had been operated for some time, and since the installation of the electrolytic lightning arresters there has been no discharge over the multi-gap, nor have there been any bad effects from lightning either in the plant or at other points on the line, which are protected in like manner.

In open-hearth plants No. 1 and No. 2 one feature not adopted in No. 3 and No. 4 will be the use of a large number of electric motors for operating the gas and air valves and furnace doors, which had previously been worked by hydraulic pressure. This will leave simply the tilting of the mixer as the only piece of apparatus in the open-hearth plant not operated electrically; and the possibilities are that even this will be changed.

PASSES	SIZE OUT	AREA OUT	WEIGHT PER FOOT	% RED.	LENGTH OF PIECE	HP ON ROLLS
1	20"	376.56	1224	21.20	67	1000
2	15"	282.37	918	25.00	90	1260
3	10"	214.87	698	23.90	118	1600
4	7½"	164.82	536	23.30	153	1450
5	5½"	130.32	424	20.90	194	8350
6	4½"	107.90	351	17.20	235	7650
7	3½"	88.90	289	17.60	285	6700
8	3"	70.76	230	20.40	358	6100
9	2½"	58.91	191	16.74	431	4500
10		44.50	145	24.40	250	5600
11		31.25	102	29.10	356	5100
12		21.80	71	29.90	511	6200
13		18.50	60	15.50	604	2850
14		16.00	52	13.50	697	5650
15		12.80	42	20.00	863	
16		10.07	33	21.33	1000	1500
17		8.62	28	14.40	1305	980
18	RAIL	8.095	26.6	6.09	1378	720

NOTE: TABLE FOR 80 lbs. 33'-0" RAILS
INGOT BUTT 20"x24"
TOP 18¾"x22¾"-65½" WT 8256 lbs.

FIG. 22.—TABLE SHOWING REDUCTIONS OF SIZE IN ROLLING 80-POUND RAILS.

A comparison between the estimated horsepower and the observed horsepower required for the various passes in the rail mill shows some discrepancy; but because the steel rolled was colder than it would have been in actual practice, since all of the machinery is new and is not operating so quickly as it should, and because also of the lack of roll adjustment, it is believed that the power required will be very little, if any, in excess of the original calculations. After the roll-train motors had been started it was discovered that the stopping of them was an important feature. The 2,000-horsepower, 214-revolutions-per-minute motor when disconnected from the rolls required two hours to come to rest, while the 6,000-horsepower, eighty-three-and-one-third revolutions-per-minute motor required one hour and thirty-seven minutes to stop. This time consumed would mean corresponding delays in case of breaking of the main spindle, which, of course, could not be countenanced. In order to stop these motors within a reasonable length of time, direct current at 250 volts was introduced into one phase of the winding through an external resistance after the motor had been disconnected from the 6,600-volt line. By this device the 2,000-horsepower motor was stopped in two minutes and fifty-five seconds, and the 6,000-horsepower motor in one minute and forty-two seconds. During this time the first section only of the resistance of the rotor was closed. This device is being put in permanently, and a 6,600-volt switch connected to one phase, the other side of which will be connected to the 250-volt line through a permanent resistance, and this switch interlocked with the main 6,600-volt oil-switch.

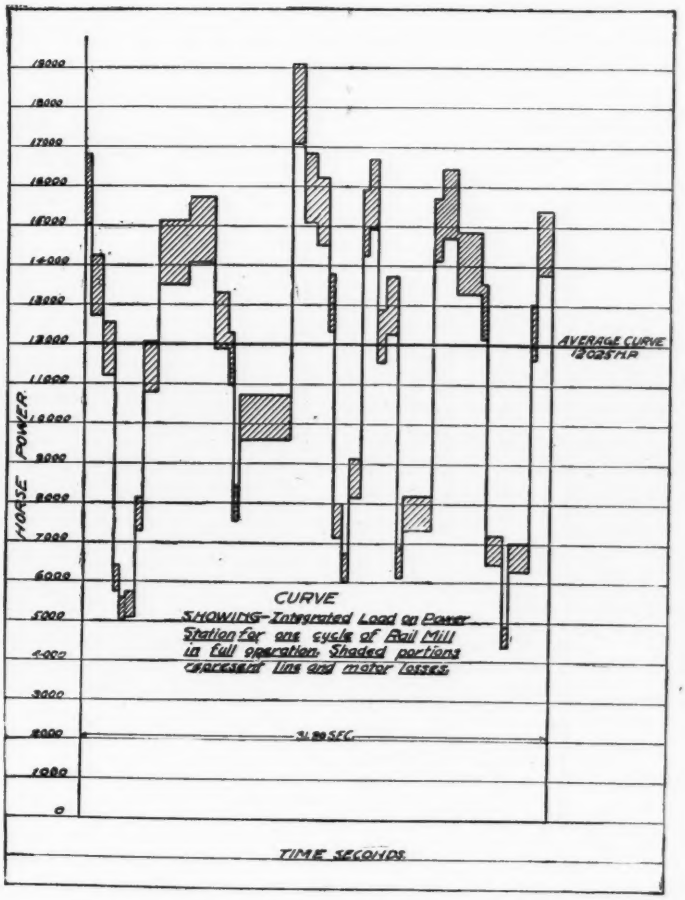

HORSE POWER
AVERAGE CURVE
CURVE
SHOWING-Integrated Load on Power Station for one cycle of Rail Mill in full operation. Shaded portions represent line and motor losses.
TIME SECONDS

FIG. 23.—ESTIMATED COMBINED LOAD ON RAIL MILL.

Probably no industrial application of electricity has been the result of more careful study on the part of the engineers in charge, or has marked a more general adoption of electric power than the one just described. Although many of the motor applications are not new, this plant is unique in respect to the number and variety of the applications and the size of many of its units. The rail mill now in operation, driven by induction motors with a combined capacity of 24,000 horsepower, and having a normal output of 4,000 tons of steel rails per twenty-four-hour day, is without a rival.

Results thus far obtained indicate that not only have the greatest expectations of the engineers been realized, but another stronghold of the steam engine has been carried, and that in the near future the rolling-mill engine is destined to give way to its successor—the electric motor.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER VII. (PART III).—THERMAL APPLICATIONS.

ELECTRIC WELDING.

Welding by means of the electric current is based upon the fact that unusual heating occurs at a poor or high-resistance contact. The current may therefore be either direct or alternating, but since for good results a current of large amperage is necessary, an alternating current with a step-down transformer is generally used.

The system of electric welding invented by Prof. Elihu Thomson provides a means of forming electrical contact between the two pieces to be welded and the terminals of the secondary of a step-down transformer and at the same time forcing them together. The resistance of the secondary winding of the transformer is very low, so that the resistance of contact of the two pieces to be welded far exceeds that of the remainder of the circuit, and most of the heating occurs at the junction.

Electric welding machines embodying these principles are made for a great variety of special purposes. Typical of such machines is one for welding steel rings. A lever operates a five-ton jack, thereby forcing the ends of the ring together, the clamps being kept cool by water circulating around them. The circuit is controlled by the operator's foot. In this way about ninety horsepower is used for fifty seconds.

In welding steel rails by electricity, current is drawn from the trolley to operate a rotary converter, which is connected to the welding transformer. The terminals of the secondary winding of the latter are connected to welding clamps on either side of the rail joint. The welding current sometimes runs as high as 27,000 amperes at seven volts, and the pressure to several tons. Fig. 150 shows an electric track-welding outfit in use on the rehabilitation of the street-railway lines in Chicago. The outfit complete consists of four cars, the first carrying a motor-driven sand-blast equipment for cleaning the rail ends, the second carrying the welding apparatus proper, as shown in the illustration, the third holding the rotary converter and control equipment, and the fourth being provided with motor-driven grinders for finishing the joints.

The electric arc is sometimes used for heating purposes, particularly in welding. In some cases an arc is struck between two electrodes and then deflected by means of a magnet, so that the flame plays upon the part to be heated. The object to be operated upon is sometimes used as one of the electrodes and an arc struck by touching it with the other electrode. The particular advantage of this method of heating is, of course, the ready centralization of heat and the high temperature obtainable.

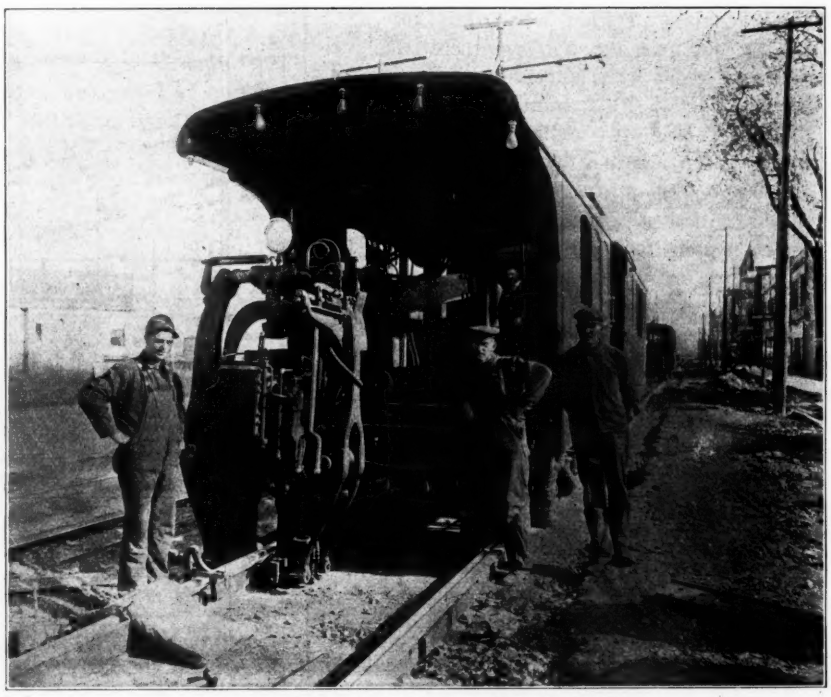


FIG. 150.—ELECTRIC TRACK-WELDING OUTFIT.

CHAPTER VIII. (PART I.)—POWER TRANSMISSION.

MODERN PRACTICE.

The advantage of the use of high-tension currents in the transmission of electrical energy, incident upon the decrease of current for the same amount of energy transmitted and the consequent decrease in the I^2R losses, has already been explained. The fact that high-tension currents can be more economically generated at the power end and more readily applied at the receiving end of the transmission line when alternating rather than direct currents are used has also been considered in a previous section. In the section on polyphase currents the decrease in the cost of installation due to the smaller amount of copper or other conductor required for the transmission of a given amount of energy by this system, as well as the adaptability of this form of electric current to the operation of motors, was explained at length.

There is, of course, a limit beyond which it is not feasible to raise the voltage. This is defined chiefly by leakage due to imperfect insulation, and which is coexistent with the use of the high-tension electric current.

EFFECT OF ATMOSPHERIC CONDITIONS.

Transmission lines are not ordinarily built to operate above 70,000 volts. Not only is there difficulty in insulating the transmission lines from the poles which carry them, but the transformer connections at the receiving as well as at the generating end present many difficult problems.

A conductor of electricity which is strung over the surface of the earth for several miles or more is influenced by the changing electrical condition of the atmosphere. For example, when a cloud becomes charged with electricity, it acts inductively on the ground and transmission line and an opposite charge accumulates in that part nearest the cloud. In other words, the action is that of an electrostatic condenser, already explained. The electrical condition of the atmosphere is liable to very sudden changes, and the result is sudden changes in the induced charges in the transmission line which may, under certain conditions, surge back

and forth, straining the insulation to the utmost.

The insulation may be compared to an elastic substance acting as the containing medium of a fluid. As the electrostatic charge accumulates at one place on the line, the insulation is endangered, just as would be the case in a rubber tube containing water if the latter should accumulate in one end; the rubber walls would stretch more and more as the water accumulated; the elastic limit would finally be reached, the rubber would burst and the water spill out. Likewise, with an induced charge in a conductor, as the induced charge assumes a greater and greater value under the influence of the inducing charge, the insulating medium separating the two is strained more and more till the limit is finally reached, when it breaks down and an electric discharge occurs. The insulating medium does not stretch mechanically, as does the elastic wall, but its insulating power is strained until it breaks down, if the accumulation of the charge be sufficient.

Electrical conductivity is only a relative term; there is no perfect conductor of electricity, neither is there a perfect insulator. The resistance of heavy copper bars in many cases is so small as to be negligible, while under ordinary conditions the conductivity of insulators used on high-voltage transmission lines is too small to be considered, and yet it is possible for the electric charge to break down the insulation and pass to earth.

ELECTRIC SURGES.

The long transmission lines now in such general use accumulate charges at different points, due to the inductive action of the electrical charges of the atmosphere. When the latter vary and the transmission system is long, electrical surges will take place in the line which are of considerable magnitude and extremely difficult to control, because subjected to so many varying influences. All of this can happen without the line being struck by lightning, simply by electrostatic induction, as already explained.

These surges are also frequently caused by internal disturbances in the transmission system, due to switching, short-circuits or grounds. For example, an arc from a transmission line over a defective insulator to ground results in a heavy rush of current and produces a series of traveling waves or recurrent surges. These phenomena, caused by abnormal internal conditions of the system, are commonly referred to as "internal lightning."

Chicago Electric Club.

At the meeting of the Chicago Electric Club, directly after luncheon on April 7, Perry Boole, of the house committee, reported on the efforts to get permanent quarters for the club. The prospects in this connection not being particularly favorable, the committee recommended that the subject be temporarily dropped. The programme for the meeting provided for a discussion of electric heating devices, the principal address being made by E. L. Callahan, of the General Electric Company.

Mr. Callahan devoted the principal part of his address to a forceful demonstration of the desirability of all interests connected with the electrical industry boosting the sale and use of electrical heating appliances. He stated that these devices, whether for household or industrial uses, have passed the experimental stage and have been developed into reliable utensils that are here to stay. While economy is still not one of the strong points of the direct electric method of doing all the cooking in the home, the recent development of the electric fireless cooker has resulted in a most promising and efficient combination. The speaker compared the trade in electric flatirons of more than ten years ago with what it is today.

F. J. Holmes, of the Vulcan Electric Heating Company, opened the general discussion by stating that electric heating in many of its applications, particularly industrial, is the cheapest as well as the best means of producing heat. To illustrate this, he cited a case where the use of electric soldering irons had been found decidedly cheaper and more satisfactory in every way than the old irons heated by gasolene torches. Harold Almert, lately of Wichita, Kan., explained why central stations had formerly sometimes found it inadvisable to push the use of electric-heating appliances and how their introduction should be effected in order to produce results satisfactory to all concerned. Leonard Kebler, president of the Ward Leonard Electric Company, emphasized the fact that most electric-heating devices are now as dependable as rheostats. G. B. Johnson, of the Commonwealth Edison Company, spoke briefly of how this company in four months put out 10,000 electric flatirons on approval. H. F. Holland, of the Pacific Electric Heating Company, closed the discussion by referring to some of the good points that make the electric flatiron so popular.

Special Railroad Rates for Machinery Manufacturers' Conventions.

It is announced that for the joint convention of the Southern Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, to be held in Chattanooga, Tenn., May 5, 6, 7, the Southeastern Passenger Association has granted a rate of one-and-one-half fares, plus fifty cents, for round trip under the certificate plan, and the Trunk Line Association has granted a rate of one-and-three-fifths fares, plus twenty-five cents, for round trip under the certificate plan.

Also, for the joint convention of the National Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, to be held in Pittsburg, Pa., May 12, 13, 14, the New England Passenger Association has granted a rate of one-and-three-fifths fares, plus twenty-five cents, on the certificate plan, for points in Trunk Line territory outside of Pennsylvania, and two cents per mile in each direction on round-trip tickets from points in Pennsylvania east of Pittsburg.

Purchases by the United States Navy Department.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on April 20 next for the following electrical supplies. Bidders interested therein should fill out the enclosed application card, giving the schedule numbers desired, and forward same to the bureau without delay.

Article.	Quantity.	Delivery at Navy Yard.	Schedule.
Batteries, storage.	1,100.....	Works	...1112
Boards, panel and cabinet distribution	.....2.....	New Orleans, La.	1110
Cable, electric, etc.	.Miscellaneous.	New Orleans, La.	1110
Conductor, rubber-covered	.....10,000 feet.....	Annapolis, Md.	1113
Supplies	.....Miscellaneous.	New Orleans, La.	1110

Railroad Electrification.

The Northern Pacific Railway Company is conducting a preliminary investigation, and is negotiating with the Madison River Power Company for electric power to operate trains over the Montana division.

The St. Paul road has already decided to electrify the division of the road, and is awaiting the development of the power project at Great Falls by John A. Ryan and associates.

HIGH-TENSION TRANSMISSION.

TWO EXCELLENT PAPERS AT THE 236TH MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; UNDER THE AUSPICES OF THE HIGH-TENSION TRANSMISSION COMMITTEE.

The 236th meeting of the American Institute of Electrical Engineers was held on Friday evening, April 9, in the Engineering Societies Building, New York city. In the absence of President Ferguson, Senior Vice-President James G. White presided.

Secretary Pope announced that at the meeting of the board of directors during the afternoon there were 105 associates elected, and the following associates transferred to the grade of member:

Charles Frederick Lacombe, New York city; Worrall E. S. Temple, Philadelphia; Johann Emil Leonarz, Mexico City; Henry Rufus King, Hawthorne, Ill.; Robert Wibley, Missoula, Mont.

The meeting was held under the auspices of the High-Tension Transmission Committee, and two especially interesting papers were presented. Abstracts of these are given below:

HIGH-VOLTAGE TRANSFORMERS AND PROTECTIVE AND CONTROLLING APPARATUS FOR OUTDOOR INSTALLATION.

BY K. C. RANDALL.

Transformers for outdoor service may be built for any requirements that the ordinary indoor type of oil-insulated unit will satisfy. As to capacity, the limit of approximately 500 kilovolt-amperes will apply to the self-cooled type, depending somewhat on voltage and frequency. As with the self-cooled indoor transformers, the case is the principal problem. It is difficult to obtain the radiating surface required for cooling very large transformers, and still retain a simple mechanical construction. Oil-insulated, water-cooled, outdoor transformers can be built for any capacity, irrespective of voltage and frequency.

Weatherproofing outdoor transformer cases is doubtless best done by making the joints vacuum-tight. Eliminating leaks means that nothing can enter, and therefore a clean, dry unit would remain in that condition. Moisture is the only enemy to be feared, either in the form of rain, snow, or humidity. The "breathing" of wet air is the most important source of trouble.

A twenty-kilovolt-ampere, 2,200 to 220-volt transformer immediately suggests a pole installation. But if the figures are multiplied by ten, a 200-kilovolt-ampere, 22,000 to 2,200-volt transformer suggests indoor service. If these figures are multiplied by three, a 600-kilovolt-ampere, 66,000 to 6,600-volt transformer certainly has always demanded housing.

The large clearance required for exposed high-tension wiring and disconnecting switches; the expensive construction demanded for enclosed high-tension wiring and switch structures; the cells or compartments often used for transformers; the space for protective apparatus—all these operate to make the high-tension station costly as compared with the low-tension station. If all high-tension apparatus were placed outside, some kind of a structure would still be required in most cases for housing the instruments, the high-tension control apparatus and the low-tension switchboard. If attendance were contemplated, some additional facilities might also be required. Under nearly all conditions, where control of either or both high and low-tension circuits is demanded, some housing will be required. Attendance, or at least frequent inspection, should usually be provided. When housing is needed for part of the apparatus, perhaps a large part, the expected advantage of placing the remaining apparatus outdoors may not become important, or may even not exist at all. In order to obtain the true comparison, the cost of the station grounds and indoor apparatus must be balanced, not only against the smaller building, but also against all the ground required for the outdoor apparatus, the outdoor apparatus itself, and the instruments and the indoor control apparatus.

The horn-gap arrester has been used considerably in outdoor service, both at terminals and along the transmission line, and the electrolytic type has been installed both indoors and outdoors. Arresters for all transmission voltages and designed for outdoor use are now available. The considerable amount of space indoors required for high-voltage lightning arresters, and its cost, are serious; in fact, arrester houses are not unknown. Outdoor types may therefore be of particular and almost independent interest.

Outdoor choke-coils differ from indoor choke-coils only in respect to case and terminals; if of the oil-insulated type, the outdoor-transformer construction will apply. It is noticeable that about the same structural problems and solutions apply to outdoor-transformer circuit-breakers and protective apparatus.

Outdoor stations should be paved and well drained around the apparatus. If this is considered too costly, individual foundations for each piece will serve. Transfer trackage with a truck, or a heavy hand truck, will be found very convenient when moving apparatus.

The general use of outdoor apparatus to the exclusion of indoor apparatus is, of course, not to be expected; but frequent applications will doubtless be made as a development of the general type of station just referred to. Transformer and switching stations present the greatest opportunities, as power houses and substations employing synchronous converters or motor-generator sets require so much housing that indoor transformers, circuit-breakers, etc., may be considered best.

The following cost estimates, based on existing installations—two equivalent indoor and outdoor 2,000-kilovolt-ampere, 25,000-volt, sixty-cycle stations—may be of interest:

Indoor Station.—High-tension apparatus inside of building. Transformers in pockets.

Approximate cost of steel building, frame erected	$ 3,100
Inside of building, including steel work..	2,300
Total for building	$ 5,400
Two 1,000-kilovolt-ampere, three-phase, 22,000-volt to 440-volt, 60-cycle transformers, delivered and erected	7,200
Switchboard for above, including two incoming line panels, step-down transformers panel and necessary oil switches	2,500
Total for station	$15,100
Outdoor station:	
Building, including outside busbar structure	$ 1,020
Two 1,000-kilovolt-ampere outdoor transformers, as above, delivered and erected	7,800
Switchboard as above (only low-tension apparatus and panels inside), all high-tension busbars and transformers outside, delivered and erected	2,625
Total for station	$11,445

From these figures, the indoor station costs approximately thirty per cent more than the outdoor station.

Another example covers the approximate costs of a 3,000-kilovolt-ampere, 22,000-3,000-volt, twenty-five-cycle motor-generator substation.

Indoor Station.—Incoming lines 22,000 volts, two of which are installed. Building structural steel, all apparatus inside, transformers in brick compartments. High and low-tension busbars and oil switches in compartments.

Length of building, 110 ft.; width, 38 ft., equaling 4,180 sq. ft.	
Approximate cost of building ready for apparatus, steel work and compartments	$21,835
Three 1,000-kilovolt-ampere, three-phase, 22,000/3,000 volt, 25-cycle, step-down transformers, delivered and erected	15,000
Three 1,000-kilovolt-ampere, motor-generator sets, motor synchronous type, 3,000 volts operating at 80 per cent leading power-factor. Generator 550/600 volts, delivered and erected	48,000
Three 45-kilowatt exciters, induction motor-driven, delivered and erected	4,500
Two incoming lines, 22,000 volts, three-phase.	
Three three-phase 1,500-kilovolt-ampere, step-down transformers panels, 22,000/3,000 volts.	
Two three-phase railway feeder panels, 3,000 volts, 3,000 kilovolt-amperes.	
Four three-phase lighting feeder panels, 3,000 volts, 500 kilovolt-amperes.	
Three panels for controlling motor-driven exciters.	
Three synchronous motor panels.	
One direct-current feeder and total output panel, 600 volts, 3,000-kilowatt switchboard, delivered and erected	20,000
Recapitulation:	
Building	$ 21,835
Switchboard	20,000
Transformers	15,000
Motor-generator sets	48,000
Exciters	4,500
Total costs	$109,335

Outdoor Station.—High-tension apparatus outdoors on concrete foundations. Building to be 110 feet by nineteen feet. Station same as above as regards output. Ordinary type of building. No steelwork.

Building	$ 7,480
Switchboard, same as above. Oil switches made weatherproof	20,200
Transformers made weatherproof	16,000
Motor-generator sets as above	48,000
Exciters, as above	4,500
Total	$96,180

The advantage of outdoor apparatus lies in cheapening the installation due to

a saving in building; there is also less life and property hazard. The disadvantages are absence of protection from weather when inspecting, overhauling or making repairs, and exposure to molesters. The problem, as a whole, was, first, the transformer; second, the switch; and third, the protective apparatus. All of these have been worked out and some experience obtained. The problem now is to decide when outdoor apparatus is warranted. This is a question of the station rather than the apparatus, and is subject to the individual conditions of each case.

CONDENSER TYPE OF INSULATION FOR HIGH-TENSION TERMINALS.

BY A. B. REYNDERS.

One convenient way of analyzing the terminal problem is to consider it as a short piece of cable. The failure of such a terminal can occur in two ways; namely, by a puncture through the insulating material separating the inside conductor from the outside conductor or support, or by "creeping" over the surface from the end of the inside conductor to the end of the outside support.

Jona, in an article on "Insulating Materials in High-tension Cables," read before the International Congress at St. Louis in 1904, shows how the distribution of stress varies throughout the dielectric, being inversely proportional to the radius. Furthermore, he shows that by grading the material according to its specific inductive capacity, it is possible to make the stresses nearly uniform throughout the dielectric.

A method that takes care of both puncture and creepage has been proposed by Ryan, Smith, Nagel and others. This method consists in dividing the dielectric by means of metal plates into a series of condensers of fixed capacities; for it is a known fact that if a difference of potential is impressed across a number of condensers connected in series, each will take its share of the stress in inverse proportion to its capacity. This principle has been utilized in constructing a terminal consisting of a small center rod or tube just large enough to carry the current, the rod being surrounded by alternative concentric cylinders of insulation and metal having the ends tapered in steps. The distribution of stress or potential gradient through the dielectric, owing to the metal layers, has been changed from a curve to a straight line. Furthermore, the ends of the metal layers fix the distribution of voltage over the surface, which thus can be kept within safe limits. This design may be designated as a condenser type of terminal.

Terminals designed in accordance with the above principles are constructed by rolling up on a metal tube, paper and mica, or paper alone, using as a bond some material like shellac. At regular increases by steps in diameter, for example one-sixteenth inch, a layer of tinfoil, making one complete turn, is inserted during the rolling process. Great care must be exercised to obtain accurate diameters, especially when the thickness of insulation is small. No air spaces or wrinkling of the paper is allowable, or poor results will inevitably follow. After being completely wound, the tube is placed in an ordinary engine lathe and the ends tapered in steps, the amount of taper depending on whether the end is immersed in oil or surrounded by air. During this turning process careful work is necessary to prevent the turning tool from "digging" into the insulation below the tinfoil, owing to concentric layers of insulation being irregular in shape instead of true circles. After the turning process is completed, the entire terminal should be treated with some insulating varnish in order to prevent the absorption of oil into that portion projecting into the oil, and the absorption of moisture in that portion which is in air.

With a terminal constructed by the above method, there yet remains one point of weakness; namely, the edges of the tinfoil are sharp, and the potential which exists between these edges and ground may be high enough to cause corona effects in the surrounding medium. If this medium is air the result of corona will be the formation of nitrous acid or ozone, which may cause a deterioration of the insulating material and an ultimate breakdown. Up to the present time no harmful effects are known on insulation from corona in oil.

It is virtually impossible to roll up a tube of insulating paper and tinfoil and obtain all layers concentric and true circles. This will be strikingly shown if the ends are tapered in a straight line. Moreover, with such ends, the tinfoil, which is usually of a maximum thickness of 0.0045 inch, is drawn out to a sharp edge, and hence the formation of corona by the breaking down of the air in contact with these edges is vastly increased. Again, it will be found that there is no fixed surface distance between the ends of the tinfoil layers, due to variations in the insulation between them. For these reasons these ends are always stepped instead of being in one straight line. Even with stepped ends, it has been found that with extremely high voltages, 250,000 and more, the tinfoil edges are sharp enough to cause the formation of corona. As shown by Jona, Ryan, Berg, and others, corona occurs when the stress on the small layer of air at the surface (edge of tinfoil) exceeds the maximum stress which the air will stand. The remedy for such a condition is to make the radius of the end of the tinfoil layer large enough to reduce the surface stress to safe limits. This result is accomplished by adding a metal ring of suitable diameter at the corners, where the tinfoil ends. This ring is electrically connected to the tinfoil. Furthermore, the addition of a metal bell of large diameter on the central rod at the top not only reduces corona from this rod, but acts as a shield or guard ring for the first few layers, with a resulting appreciable gain in the creepage strength of these layers.

The question naturally arises: If this style of insulation is effective for terminals, why could it not be used for the insulation throughout the transformer? The terminal proposition is one of concentric cylinders, and, if the particular insulation in the transformer is of a similar shape, there is no reason whatever why the condenser type should not be used; its effectiveness, however, is less and less as the diameters of the layers become greater, and the difference between diameters becomes less. In other words, as the layers approach nearer and nearer to a flat surface the potential gradient approaches nearer and nearer to a straight line.

If the condenser type of insulation in the form of a tube is used between primary and secondary or primary and ground in a core-type transformer and the metal layers in the tube are connected electrically to points of equal potential in the windings, then not only is the distribution of stress in the dielectric fixed, and hence the total dielectric strength increased, but the action of the condensers assists in the suppression of surges due to outside disturbances.

It is probable that by the use of the above method of connecting the winding and the metal layers together, and the use of condenser types of terminals, transformers of 300,000, 400,000 or 500,000 volts may be made on a convenient basis.

A number of demonstrations of high-tension terminals was made by Mr. Reynders, the potential being raised to 165,000, 220,000, and 225,000 volts.

The discussion was opened by W. S. Moody, of the General Electric Company, who said that it must be evident that there is one feature of such a lead as Mr. Reynders describes that requires more or better insulating material when the condenser cylinders are introduced than when they are not. This is that with the condenser plates in place every weak spot in the insulation is in series with every other weak spot, whereas a lead covered entirely with insulating material is not weakened greatly by any one of its weak spots, because this weak spot will not, ordinarily, by the mere law of probabilities, be in series with any other weak spot. This may be no serious objection. It would seem that by far the greatest value to be obtained from the construction is in the equalization of the strain along the exterior surface of the lead, and there would seem to be no question but what the practically equal distribution of strain that can be and has been obtained from the condenser type construction, does require the minimum length of lead to withstand a given voltage, provided one confines himself to a plain cylindrical or

conical surface for the exposed part of the terminal.

Mr. Moody described the designing of a 500,000-volt transformer, nearly eight years ago, by his assistant, J. J. Frank.

In the preliminary tests leading up to the designs of this transformer it was found that when an air or oil space was under electrostatic stress the introduction into this space of several sheets of metal lowered the voltage required to puncture, whereas the introduction of several sheets of insulating material (consisting of something that was inferior to oil or even air as an insulation) markedly increased the voltage required to puncture.

It was therefore decided to subdivide the oil space which was chosen as the only practical material against puncture for any such pressure as half a million volts by insulation cylinders of solid material rather than by metal.

In attacking the problem of surface insulation it was clearly apparent that the fifteen to eighteen feet of such surface that would be required could hardly be attained in a straight line, but that some form of regular surface, such as is used in line insulators, must be resorted to.

Combining these ideas resulted in the production of a lead about sixteen inches in diameter where it passed through its support and about eighty inches long either side of this support. This lead has for six years, in connection with all sorts of special testing, been in most frequent use, and subjected to from 300,000 to 650,000 volts.

This lead consists of a tube of low-grade insulating material tapering in diameter both ways from the point at which the lead is to be supported, the tube being filled with a high-grade insulating liquid or semi-liquid compound, such as oil or asphaltum. The tube is made up of sections telescoping into each other slightly, and between each section are rings of similar material projecting beyond the sections, to give very great leakage distance on the surface. In the later forms of these sections the projecting part is made integral with the section, so that the section has the general appearance of the petticoat of a line insulator. All the sections are drawn tightly together, after a suitable cement has been placed between them, by the conductor itself, which is a heavy rod or tube. The space between the walls of the tube and the conductor is divided into several sections by thin cylinders of insulating material. The entire air space in the lead is then filled with insulating compound.

The dimensions of a lead regularly used for 100,000-volt transformers, which is regularly tested at 200,000 volts, and some of which have stood 225,000 volts for fifteen or twenty minutes are:

Diameter, seven-and-one-half inches.

Length, thirty-nine inches. .

Percy H. Thomas said, with reference to outdoor transformers, that if the climate is at all bad, it would preclude the outdoor apparatus; in any such climate as New York, where there is much sleet and snow, where one cannot always open the apparatus and look at it, there would be some difficulty experienced.

Mr. Thomas said that in the examples Mr. Randall pointed out it seems to him that the saving is incommensurate with the amount of risk and difficulty, but he judged that this would not be true in all cases.

Referring to the condenser type of terminal, Mr. Thomas was inclined to believe it the part of wisdom not to attempt to pass the high-tension terminals through too small diameter An eight-inch opening through the metal cover reduces strains and the tendency of corona discharge. Effort should be expended on making the mechanical construction of the larger insulating diaphragm more suitable, rather than attempting to find some way of carrying the high potential through a small hole.

D. B. Rushmore, of the General Electric Company, pointed out a number of conditions which appeared to him to oppose the use of the outdoor substation. The question, he said, was hardly one of engineering; it was rather a question of economic necessity. It was a case of not, "Can we use the outdoor substation?" but "Where will we have to use it?"

Paul M. Lincoln, of the Westinghouse Electric and Manufacturing Company, said that when the construction of the condenser type of terminal was first taken up, it was feared that the lining up of the weak spots would prove fatal, and it was not until after the thing had been tried out thoroughly, time and time again, that it was found that that defect was not fatal by any means; that the lining up of these weak points does not exist, and that by the kind of material which is put into the terminals and bushings the weak points are practically eliminated.

E. M. Hewlett said that with a highly insulating shell, with sufficient creepage distance, an insulator has been developed which has practically the same striking distance as the equivalent spark-gap, and by making it of great enough diameter to stand the puncture, and making the puncture value a little higher than the equivalent spark-gap value, it accomplishes all the purposes which it is called upon to accomplish.

S. Piek stated that the Niagara, Lockport & Ontario Power Company has six outdoor 60,000-volt transformers since October last, with which there has been no trouble of any kind with the terminal. These transformers have given perfect satisfaction, and in each case they save about $2,000 in construction cost, so that, as regards an operating company, there is a great field for the outdoor transformers.

Ralph D. Mershon, chairman of the High-Tension Transmission Committee, announced a number of contributions to the discussion. There was not time to read all of these, but they will be incorporated in the report of the committee.

Guido Semenza, of Milan, Italy, is of the opinion that if we take into account the cost of operation, the larger liability of breakdown, the necessity of frequent repainting, of cleaning away dust and insects, and the greater amount of inspection, it will more than offset the lower first cost of installation.

A contribution from A. E. Kennelly and one from J. S. Peck, of Manchester, England, were read. Mr. Mershon then discussed the papers of the evening and took up also several of the points brought out in the discussion. He said there were two suggestions made by Mr. Randall which were especially interesting. One of these is that of considering the high-voltage apparatus a part of the transmission line, and switching the apparatus and line as a unit. This course of procedure will, in time, prove desirable in many cases where large amounts of power are to be handled, and the transmission is over long distances. The other is that of putting all the high-voltage apparatus in one tank, so as to require the minimum number of terminals. He agreed with Mr. Piek that Mr. Randall had not allowed enough for the cost of his buildings. J. S. Peck's contribution raises an interesting point, and that is the fact that using single-phase transformers with the high-voltage side connected in Y, we need only one high-voltage terminal for each transformer; and that by such method of connection, we may locate our series transformers near the neutral point, thus avoiding the necessity of insulating them for high voltages. If such course is pursued, it might possibly pay to go further and bring a lead out from the high voltage winding near the neutral

connection, from which could be actuated the voltage-measuring instruments and the reverse relays, where such are required.

If separate single-phase transformers are used in three-phase transformation, with both high-voltage and low-voltage windings connected in Y, each transformer and the line cable connected to it may be treated as a single-phase unit. That is, the three-phase transmission circuit may be considered as made up of three single-phase circuits 120 degrees apart, and handled accordingly, so that where the return current through the ground would not be especially objectionable, we might, in cases of emergency, switch out a part or all of the transforming apparatus connected to one line conductor, and run for a while on the other two phases. Of the many written contributions received, one of those, for the reading of which there was not sufficient time, deals with the idea of locating the high-voltage busbars and some of the remainder of the high-voltage apparatus on the roof of such small building as may be required for sheltering the substation operator and the switchboard measuring and control apparatus.

The discussion was participated in by Prof. W. S. Franklin, N. J. Neall, G. Faccioli, C. L. de Muralt, V. D. Moody, M. W. Franklin, L. L. Perry, W. L. Waters, A. H. Kreusi, S. Kos, F. G. Baum, O. S. Lyford, Jr., Carl Schwartz and J. B. Whitehead. These contributions will all be included in the published Proceedings of the Institute.

A vote of thanks was passed to the Electrical Testing Laboratories, New York city, for lending the high-tension testing apparatus, and to the New York Edison Company and the United Electric Light and Power Company for installing the apparatus and furnishing current.

Proposed Retaliatory Patent Law.

Representative Stephens has introduced a bill in Congress to subject citizens of foreign countries applying for United States patents, copyrights, etc., to the same fees, rules and regulations as are imposed on American citizens in the country of the applicant for securing patents or copyrights or for manufacturing and selling the same, non-compliance with this law to entail forfeiture and cancelation of the privilege granted. Citizens of foreign countries having no copyright or patent laws, or of those countries which discriminate against American citizens in this respect, are not to be entitled to copyrights or patents in the United States.

Electrical Exposition at Louisville.

The Southern Electrical and Industrial Exposition at Louisville, Ky., was opened at 1:30 p. m. on Monday, April 12, by President Taft, who, in Washington, D. C., pressed the electric button that caused the countless electric lights to glow and the wheels of the machinery on exhibition to turn.

The show is one of the best of its kind ever given, and for months past the moving spirits of the enterprise have been untiringly at work, with the result that Secretary Macdonald was able to announce that the show was entirely out of debt at the opening of its doors.

With the exception of Sunday, April 18, the exposition will be open every day, including April 24, from 11 o'clock in the morning until close to midnight.

The displays embrace the very acme of invention in the electrical world, from an electrically-heated flatiron to a hundred-horsepower driving motor, from an electric curling-iron to an electric cooking cabinet.

Here one finds a powerful engine capable of driving thousands of wheels and spindles, and there is a tiny mechanism by which sweet strains of music please the most sensitive ear. In another booth is the electric cooking range; in another an electrically driven sewing-machine moves automatically while a pretty girl sends the fabric beneath the needle.

TOWER SQUARE, THE SOUTHERN ELECTRICAL AND TRADES EXPOSITION, LOUISVILLE, KY., APRIL 12-24.

Not alone are the electrical industries represented there, but many of the more important manufacturing concerns of the Falls Cities. Numerous interesting exhibits foreign to the electrical class are there. The highest class of manufacture is represented and are being demonstrated by experts.

The opening speech was made by President Fred W. Keisler, and the mayor, the Governor's staff and many other important personages were present at the opening.

Proposed Franchise for McAdoo Subway Extension.

The New York Public Service Commission made public on April 10 the form of the franchise for the McAdoo Tunnel extension to the Grand Central Station, New York city, which will be suggested of the hearing on April 23.

The tentative draft suggests the possibility of having a station in the McAdoo Subway at Forty-second Street and Fifth Avenue, as well as one at Thirty-eighth Street and Sixth Avenue, in that it stipulates that the payment to the city for each one of the stations so placed shall be $500 annually for each entrance or exit from the time when the actual operation of the tube begins. The other payments stipulated in the franchise are to be at the rate of fifty cents a year for each linear foot of track and station platforms after the beginning of operation for the first ten years, and thereafter $1 a year for each foot of such tracks on platforms from the end of the first ten years to the date when the present McAdoo franchise becomes subject to readjustment.

In addition the McAdoo company is to pay to the city for rights under streets, parks and public places $9,000 a year for ten years, which, according to the estimate of the commission, is three per cent of the anticipated gross earnings and five per cent of the gross earnings annually thereafter until the time when the existing franchise becomes subject to readjustment, in 1933. As rental for vault space, not including station platforms and space otherwise specified, the McAdoo company is to pay a sum equal to four per cent a year on the valuation of the horizontal area of such space, this value to be based upon the value a square foot of the neighboring land, exclusive of buildings, as fixed for taxation for the year 1909. For the first ten years of the franchise one-fourth of this value is to be taken as the value of the vault space, and thereafter one-half, until the date when the franchise comes up for readjustment.

It is provided in the franchise that the subway shall be constructed without opening the surface of the streets, except in such cases as the Public Service Commission may issue a special permit, and that the tracks must be constructed in the most approved manner to avoid noise or tremor from operation. The company is to file a bond of $200,000 before beginning construction, and it must obtain the consent of the Board of Estimate and Apportionment within six months after the franchise is granted, and the consents of the owners of one-half the value of the property in the streets under which the tunnel passes, within one year. The limit may be extended for three months in case the company has not obtained the requisite number of consents within the year, or in lieu of the consents, the determination of commissioners appointed by the Appellate Division of the Supreme Court may be obtained and filed with the Public Service Commission.

The franchise makes this provision regarding the acquisition of the subway by the city after twenty-five years:

In case the city or the commission shall at any time or times hereafter determine that the railroad hereby authorized is necessary or desirable for use as a part of some municipal system of rapid transit to be owned by the city, the city shall have, and the tunnel company by the acceptance of this instrument hereby grants to the city the right and option to purchase and take the railroad hereby authorized at any time or times after the twenty-sixth day of February, 1933. In case the city or the commission determines to exercise said option or acquire the railroad hereby authorized the city or the commission shall give the tunnel company at least two years' notice in writing; and upon the day fixed by said notice for such acquisition the city shall pay or tender to the tunnel company the value of the railroad hereby authorized (but not including the franchise hereby granted) as determined by agreement or by appraisal in the manner provided in Article 11 of this certificate; such value, however, not to exceed the actual cost in money of the construction of the railroad hereby authorized, including cost of stations, real estate, and any easements, structures, and property connected therewith and necessary therefor, as the same exists at the time when the said option shall be exercised.

New Directors for Hudson Companies.

At a meeting of the board of directors of the Hudson Companies, the holding company for the Hudson & Manhattan Railroad Company, on April 7, Dumont Clarke, president of the American Exchange National Bank, A. A. Tilney, a partner in the house of Harvey Fisk & Sons, and Charles Francis Adams, 2d, of Boston, were elected directors to succeed Gardiner M. Lane, Cornelius Vanderbilt and Andrew Freedman.

The three latter resigned from the directorate at the time the application was made by William G. McAdoo for a franchise to extend the present McAdoo system from Thirty-third Street to the Grand Central Station, New York city, as they were directors of the Interborough as well as of the Hudson Companies.

New York City Railway Earnings.

The New York State Public Service Commission gave out on April 5 a compilation of the income, traffic and physical statistics of the surface lines that formerly comprised the New York City Railway system, for the year ended June 30, 1908. It was the first time that the figures had been brought together for the whole system for the year in which the receiverships intervened, and separated it into its present component parts.

In general, the results of operation showed a marked decrease of gross earnings for the year, as compared with the preceding year, and with even the defaults of interest and rentals that had been entered up to June 30 of last year the whole system showed a deficit of $1,886,800. For the year ended June 30, 1907, the deficit was $3,330,201.

The traffic figures were not complete, as those of the Third Avenue and the One-Hundred-and-Twenty-Fifth Street crosstown lines stopped with February 12, 1908, when the Third Avenue receiver was appointed. With the Third Avenue and One-Hundred-and-Twenty-Fifth Street crosstown figures missing from that date, the system operated 50,837,061 car-miles and carried 312,990,952 revenue passengers and 174,447,779 transfer passengers.

To Supplant New York City Horse Cars.

Frederick W. Whitridge, receiver of the Third Avenue Railroad, New York city, announced that on April 15 he would install as an experiment on the two horse-car lines in the Third Avenue system two self-propelling cars, one of the electric storage-battery type and one of the gasolene type built by the General Electric Company, Schenectady, N. Y.

These two horse-car lines are the Dry Dock, East Broadway & Battery line and a branch of the Forty-second Street, Manhattanville & St. Nicolas Avenue line on St. Nicolas Avenue. Mr. Whitridge said that if the cars prove successful it would be practicable to supplant all the existing horse cars with whichever type proved the more economical.

The new cars will hold twenty-eight persons and are thirty-two feet long. It is thought possible that they may be introduced in West Street, where the Metropolitan Street Railway has always claimed that the action of the tides has made underground conduits impracticable. The city has never consented to the use of overhead trolley wires there, so that horse cars have had to be used.

Bi-Monthly Meeting of the Central Electric Railway Association.

The regular bi-monthly meeting of the Central Electric Railway Association was held in the Hollenden Hotel, Cleveland, Ohio, March 25, and was successful in every way. The attendance was unusually good, considering the great distance many of those present were compelled to travel.

The programme was a short one, but the topics considered brought out a hearty discussion. The meeting was called to order by A. A. Anderson, of Columbus, Ind., president of the association. After the reading of the minutes of the previous meeting and the disposal of some routine business, President Anderson took occasion to thank the members of the association for honoring him with its presidency. He presented an outline of what he had planned and desired to have accomplished during his administration, and emphasized the value and necessity of co-operation in the work of the association.

The first topic on the programme, "Little Things in Connection with Operation," was presented in a paper read by W. A. Carson, general manager of the Evansville Railway Company. Abstracts from this paper follow:

Old material should never be scrapped or new material issued without the approval of some competent department head. New material and supplies should be kept in a properly equipped and orderly storeroom, and the responsibility of maintaining such storeroom centered in one employe. Accurate records should be kept of all materials and supplies taken into the storeroom, and nothing should be issued without a properly approved requisition which states to whom and for what purpose the material is issued. Heavy materials, such as rails, ties, etc., stored along the line should also be looked after and checked and record kept by the storekeeper. In this way accurate distribution of maintenance accounts is made possible. A card index of all purchases with a few minutes' work each day in the office enables a detailed record to be kept of the different materials and supplies purchased, which shows the order number, the date same was placed, quantity ordered and the price and discount covering same. Employes who check material received should be required to check all shipments carefully and accurately as to weight, quantity, etc. To maintain discipline among employes, violation of minor rules should never be overlooked as of no importance, as by calling attention to these minor cases infraction of more important rules and regulations will be prevented. At intervals written examinations on the operating-rule book should be given all employes whose duties have anything to do with the operation of trains, and all employes making a grade of less than eighty-five per cent should be required to take another examination. Three failures to grade better than eighty-five per cent should be sufficient cause for dismissal. These examinations should also cover special orders which have been posted from time to time. There are very few roads that do not have friction between the shop and transportation departments, and unless the heads of these two departments work in harmony and keep down the criticizing spirit in the men under them a feeling will soon exist that will be detrimental to the company's interest. To promote a kindly feeling in the organization, it is a good idea to have periodical meetings of executive heads to discuss freely all of the work in the various departments, especially that which laps over from one department to another. Meetings of all employes in every department should be held at intervals and talks given by the management and the various department heads, and an endeavor made to have them bring up for discussion new conditions which come up from time to time; the policy of the company with reference to such matters should then be decided upon and explained.

Mr. Carson's paper provoked considerable discussion, especially on the merit and demerit system now in use by some companies, and described by him. Those participating in the discussion were C. D. Emmons, general manager of the Fort Wayne & Wabash Valley Traction Company; C. C. Reynolds, general manager of the Terre Haute, Indianapolis & Eastern Traction Company; C. M. Wilcox, general manager Cleveland, Southwestern & Columbus Traction Company; F. D. Carpenter, general manager of the Dayton & Lima Traction Company, and C. L. Henry, president of the Indianapolis & Cincinnati Traction Company. The speakers were about equally divided in their advocacy of the merit and demerit system.

The first paper read during the afternoon session was presented by J. N. Nelson, Jr., of the Department of Agriculture, Washington, D. C., on "Preservative Treatment of Timbers Used by Electric Traction Companies." Mr. Nelson declined to favor any particular method of treating timber, but showed very conclusively how the life of ties and bridge timbers could be doubled and the safety of operation greatly enhanced. He referred to the rapid depletion of the native forests and deemed it the duty of electric roads to take such action as will lessen the demand for timber. Mr. Nelson's paper was well received and brought out a number of inquiries relative to the comparative cost of treated timber with that which had not been treated.

The concluding paper was read by R. N. Hemming, assistant superintendent of the Ohio & Southwestern Traction Company, on "Loose-Leaf System of Filing of Matter in Periodicals." After asserting that a proper system of filing information adds greatly to its value, he pointed out an ingenious method of filing technical and descriptive matter by taking out the leaves of the journals and making a new volume, with matter classified and indexed. He said it was the experience of all that when information contained in an article was wanted it could not be found without the sacrifice of too much time. He said magazines of this character could be published and sent out in loose sheets and then easily grouped under heads of like subject-matter and indexed. Such a plan would provide for the ready and intelligent use of periodicals.

At the close of the meeting the members were taken on an excursion and inspection trip to the Hollinwood-Kuhlman Car Company's shops and were shown every courtesy by the general manager of the plant.

The association adjourned to hold the next meeting in Fort Wayne, the first Thursday in June.

Cleveland Industrial Exposition.

The Cleveland Industrial Exposition is announced to take place June 7-19 under the auspices of the Cleveland Chamber of Commerce.

The temporary building in which it is to be held covers an area of about 60,000 square feet and connects by an overhead bridge with the Central Armory, which is also to be utilized, thus giving a total floor space to the exposition of 115,000 square feet.

The lighting arrangements call for 15,000 incandescent electric lights.

QUESTIONS AND ANSWERS.

CURRENT THROUGH THE HUMAN BODY.—What current in amperes will the average human system stand without injury? Between what limits does this value lie for adults?—A. H. R., North Abington, Mass.

The amount of current that it is safe to pass through the human body depends upon many considerations, such as the part of the body through which the current passes, the state of health and general condition of the person, the duration of the current flow and its character, whether direct, interrupted, pulsating or alternating. The flow of current through the body is believed to be of an electrolytic nature, accompanied with its attendant dissociation or disintegration of the conducting path as well as, if not more than, the points of application. If the current is not too great the disintegration is not harmful, but may, on the contrary, be beneficial, as in many electro-therapeutical applications. The currents distribute themselves through the various organs and tissues in shunt paths inversely proportional to the resistances of these paths between the electrode terminals. If the area of the electrodes is large a larger total current may be passed without particular pain or harm in any particular organ. Currents applied to the head should not exceed five or at most ten milliamperes. In the abdominal region currents up to 200 or 250 milliamperes may in extreme cases be employed. These figures indicate roughly the limits of current for adults. However, on account of the great variations between individuals it is impossible to state definitely what is a safe limit except that in general the manifestation of sharp pain is a good point to stop.

STUDY OF ELECTRICAL PRINCIPLES.—Could you kindly tell me how I may learn the principles of electrical engineering? I am regularly employed, and in spare moments have studied for two-and-one-half years from a number of electrical books, some of which I found too mathematical, although I got a great deal of help from them. I will thank you for suggesting to me how I may make more rapid progress.—O. H., Scribner, Neb.

Individual study, such as you have been pursuing, has been the means for thousands of men in mastering the world's knowledge. In a technical study, such as electrical engineering, however, progress along such lines will be very slow, unless one has the aid of a regular instructor, or at least of some one versed in the subject, as well as means for coming in actual contact with the electrical appliances and machinery studied, as is afforded in an electrical laboratory, shop or power plant. A fellow employe or superior in one of the latter may help you greatly. It would be desirable for you to apply for a position, even though it be menial, in the electric plant of your own or some adjacent town. For a person regularly employed by day and so located that he cannot attend the evening classes of a good technical school, a desirable plan is to enroll as a student with one of the well-known correspondence schools that teach engineering subjects systematically by correspondence. The courses in these schools have been dveloped for just such students as the inquirer seems to be and have been found to give a fairly good grasp of the fundamental principles and their more important applications.

VARIATION IN STORAGE-BATTERY CAPACITY.—Recently I came across a catalogue of storage batteries, which gave the capacity and dimensions of various cells. I found, for instance, that a cell giving thirty amperes for eight hours would give sixty amperes for only three hours, and 120 amperes for only one hour. Why is this, and is it general with all storage batteries?—A. F. B., Memphis, Tenn.

The figures given show a general characteristic of all storage batteries to have a lower capacity when discharged at high current rates than when discharged at lower rates for a longer time. The chemical reactions that take place on both the positive and negative sets of plates, and which result in the generation of the discharge current, consist in the formation of lead sulphate by the combination of the sulphuric acid radicle of the electrolyte with the lead of the sponge lead negative and the lead of the lead peroxide positive. This lead sulphate is an inert substance that clogs the pores of the active material. The rate of its formation is strictly proportional to the discharge current rate. If this rate is high, as in a one-hour discharge, for instance, a great deal of lead sulphate is formed on and close to the surface of the plates, thus preventing the diffusion of the electrolyte into the interior pores of the active material and rapidly exhausting the surface layers. At low rates of discharge, such as the eight-hour or longer, the formation of sulphate extends more completely into the interior of the active material, so that a larger percentage thereof enters into the reaction and thus produces more prolonged current flow before it becomes exhausted.

PARTY LINES AND ALTERNATING-CURRENT MACHINES.—(1) Is the common party line a combination of the series and parallel instruments? (2) Are all alternating-current motors with armature windings synchronous motors? (3) In railway work has the rotary converter advantages over the motor-generator set, and, if so, what are they? (4) What is the principle upon which a synchroscope works?—C. A. S., Los Angeles, Cal.

(1) The common party line is now almost exclusively equipped with bridging (parallel) telephone instruments only. (2) No. In one sense every motor has an armature winding, although in alternating-current motors it is more common to speak of the stator winding on the stationary part and the rotor winding on the rotating part. In any motor there are always at least two windings. (3) The rotary converter has advantages over the motor-generator set that are not essentially different in railway work from what they are in other classes of service. Among these advantages are: higher efficiency, a single machine instead of two, and therefore less attention and space required, quicker response to load changes and better regulation. (4) The synchroscope is built on the revolving-field induction-motor principle. It has a pointer connected to the rotor of a small induction motor whose revolving field is set up by any difference in time-phase between the two machines being synchronized. The pointer revolves to the right or left, depending on whether the speed of the incoming machine is less or greater than the synchronous speed of the one in service. When the two speeds are in exact synchronism the pointer stops and, when the phases are also correct, points to the initial position.

Electrical Inspection Bill for Philadelphia.

A new electrical inspection bill for Philadelphia has been introduced in the Senate for the purpose of regulating electrical construction.

Persons, firms or corporations engaging in electrical construction must first get a permit from the Department of Public Safety for $5. Applicants for license must be examined by a qualified electrician and pay a $10 fee.

Licenses may be revoked or suspended by the chief of the Electrical Bureau, but the right to appeal before a board of disinterested electricians is given.

Councils are to provide inspectors, examiners and other employes to carry out the law. The penalty for non-compliance with the law is $500 fine and three months in jail. The act does not apply to telephone, telegraph, electric lighting, power or railway companies.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

TENTATIVE PROGRAMME FOR 1909 CONVENTION.

The following tentative programme has been announced for the convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 1, 2, 3 and 4. The plans for the exhibition by Class D members are being rapidly completed, and arrangements have been made for special rates, on the certificate plan, from all points in the territory covered by the various passenger transportation associations:

Tuesday, June 1—A. M.

First Session—President's Address. Announcements. Report of Committee on Uniform Accounting; H. M. Edwards, chairman. Report of Committee on Progress; T. C. Martin. "Private Policy," Paul Lüpke. Report of Committee on State and Company Branches; R. M. Searle, chairman.

Tuesday—P. M.

Second Session—Opening Address. "Latest Developments in Street and Park Lighting;" J. W. Cowles. Report of Committee on Meters; G. R. Green. Illustrated Lecture, "Quality of Light;" Paul Bauder.

Wednesday, June 2—A. M.

Third Session—Manufacturers' Day.—Hitherto unpublished information concerning new apparatus. "Advanced Information Regarding Developments in Storage Batteries;" Jos. Appleton. "Advanced Information on New Types of Arc Lamps;" A. J. Mitchell. "The Status of the Arc Light;" N. R. Birge. "Recent Types of Arc Lamps and Their Operations," C. E. Stephens. "Methods of Manufacture of Incandescent Lamps, Carbon, Metallized, Tantalum and Tungsten, Showing by Samples Various Processes," J. E. Randall. "Some Recent Developments in Electrical Apparatus;" E. W. Allen. "Distributing Transformers as of Interest to Central Stations;" E. G. Reed. "Future Requirements of Central Station Companies;" P. Torchio.

Wednesday—P. M.

Fourth Session—Executive.—Report of Treasurer John F. Gilchrist. Report of Committee on Public Policy; Samuel Insull, chairman. Report of Lamp Committee; W. W. Freeman, chairman. Report of Insurance Expert; Wm. H. Blood, Jr. Appointment of nominating committee.

Thursday, June 3—A. M.

Technical Session No. 1—Report of Committee on Gas Engines; J. B. Klumpp, chairman. "Condenser, Cooling Towers and Auxiliaries;" M. R. Bump. "Reactances in Connection with Turbo-Generators;" P. Junkersfeld. "Unique Features in Power Plant Design;" G. L. Knight. "All-Day Efficiency Tests on Station Transforming Apparatus;" S. M. Farmer. "Low-Pressure Turbines;" C. H. Smoot.

Thursday—P. M.

Technical Session No. 2—Report of Committee on Grounding Secondaries; W. H. Blood, Jr., chairman. Report of Committee on Protection from Lightning and Other Static Disturbances; B. E. Morrow, chairman. Report of Committee on Overhead Line Construction; Paul Spencer, chairman. "Transformers;" W. A. Layman. "Recent Development Work on Distribution Systems;" W. K. Vanderpoel. "Performance Specifications for Electrical Machinery;" W. L. Waters. "Central Stations in Towns of Less than 4,000 People;" J. S. Knowlson. "Requirements and Specifications for Extra High Potential Transmission Lines;" A. S. Ives.

Commercial Programme, Thursday, June 3—A. M.

First Session—"Methods of Introducing Tungsten Lamps and Their Effect on Central Station Income;" W. H. Atkins, editor. "Practical Illuminating Engineering in the Commercial Department;" G. A. Sawin, editor. "Cost of Obtaining New Business;" R. M. Searle, editor. "Can a Display Room Be Conducted Upon a Profitable Basis?" Frank B. Rae, Jr., editor. "Advantages to Be Derived from Uniform Commercial Department Forms and Methods;" C. N. Stannard, editor.

Thursday—P. M.

Second Session—"Compilation of Load Factors;" E. W. Lloyd, editor. "Power;" H. J. Gille, editor. "The Advantage of Group Drive in Certain Installations;" C. A. Graves, editor. "New York High-Pressure Fire System." "The Development of Revenue from Existing Customers;" T. I. Jones, editor. "Adoption of Electrical Heat for Industrial Purposes;" Charles J. Russell, editor.

Friday, June 4—A. M.

Third Session—"Electricity for National Advertising;" George Williams. Council of Progress. Executive Session.

Friday—P. M.

Fourth Session—"Isolated Plants;" R. S. Orr, editor. Lighting. Power. Arguments successfully used. Experience of various companies. "Central-Station Operation of Steam Plants in Connection with Lighting Company's Service;" S. Morgan Bushnell, editor. "Novel Methods of Advertising in Small Towns;" Alex J. Campbell, editor. "Electricity for Domestic Purposes;" M. E. Turner, editor. Installation. Domestic Appliances. "Effect of Various Conditions of Maintenance on the Efficiency of Illumination;" A. L. Eustice, editor. "Relation of Electric Vehicles to Central Station Business;" Hayden Eames, editor. Unfinished business.

Accounting Programme.

"Depreciation;" G. E. Claflin. "Payrolls;" W. W. Freeman. "Cost Accounting;" A. V. R. Coe. "Supplies;" E. A. Baily. "Branch Offices;" E. J. Allegaert.

The Taxation of Waterpower.

In a valuable paper contributed to the joint conference recently held by the four national engineering societies in New York city, Lewis B. Stillwell discussed the relation of electricity to the conservation of energy, emphasizing the point that any tax upon a waterpower might tend to its retardation, as it is a well-proven fact that there must be a large measure of opportunity for profitable returns, or the creating of a hydroelectric development would be an economic failure. The proposition to pay for inland waterways by the proceeds of what would be in fact a tax upon waterpower, was of very doubtful wisdom from an economical standpoint. It is unfortunate that in reporting this meeting in a recent issue, Mr. Stillwell was made to say it would be a matter of "double" wisdom. The correct interpretation was, of course, obvious.

Southwestern Electrical and Gas Association.

The convention of the Southwestern Electrical and Gas Association will be held at Dallas, Texas, on May 20, 21 and 22. The headquarters of the association will be at the Hotel Southland. The large billiard room and several rooms in the basement will be set apart for the purpose of holding an "Electric and Gas Trades Display." Exhibit space will be furnished to members of the association free, unless they require more space than that incorporated in the different divisions, when an additional charge will be made. It is expected that the Electrical Contractors' Association of Texas will join with the association in this convention.

An elaborate souvenir programme is being prepared by H. T. Edgar, manager of the Northern Texas Traction Company of Fort Worth. Arthur Curtis Scott, professor of electrical engineering, University of Texas, will be in charge of the Question Box. There will be a number of papers on practical and technical subjects by men prominent in various lines.

The organization embraces all electric-lighting, gas, street-railway and telephone interests in the Southwest, having members in Louisiana, Oklahoma, Arkansas, Arizona, Mexico and Texas. There are about 250 members, and it is expected that there will be a number of adhesions between the present time and the opening of the convention. From the active way in which the supply men are taking hold of the exhibit part of the convention, it is expected that the display will be both interesting and comprehensive.

The officers of the Southwestern Electrical and Gas Association are: Ralph B. Stichter, general manager of the Sherman-Dallas Interurban Company, president; W. B. Tuttle, vice-president and general manager of the San Antonio Gas and Electric Company, vice-president; W. B. Head, general manager of the Stephenville Electric Light Company, second vice-president; Joe E. Carroll, manager of the Beaumont Ice, Light and Refrigerating Company, third vice-president; D. G. Fisher, assistant secretary. Executive committee: A. E. Judge, president of the Tyler Electric Company; H. T. Edgar, manager Northern Texas Traction Company, at Fort Worth; H. M. Moore, manager Austin Gas Light Company; Fred M. Lege, Jr., manager Brush Electric Company, Galveston; E. L. Wells, Jr., manager Arkansas and Texas Consolidated Ice, Light and Coal Company, Marshall, Texas.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

IMPROVED MOVING-COIL GALVANOMETER

The moving-coil galvanometer is now used so extensively on account of its insensibility to outside magnetic disturbances that Dr. M. Reinganum's article in the *Physikalische Zeitschrift* for February 1, describing two methods of making the instrument suitable for measuring smaller currents than it has been capable of measuring previously, will be welcomed by many of our readers. In the first method a piece of soft iron wire, about six centimetres in length and 0.33 millimetre in diameter, is attached to the top of the coil outside the strongest part of the magnetic field, and at right angles to the lines of the field. In the second method a similar piece of magnetized steel wire is attached to the coil parallel to the field, but with its poles reversed. In each case the sensitiveness of the instrument is greatly increased, and in one case described by the author, with the steel wire, it was raised to ten times its original value without the deflections ceasing to be proportional to the current passing through the coil.—*Abstracted from Nature (London), March 4.*

THE NITRIC ACID INDUSTRY OF NORWAY.

In a recent address before the Swedish Society of Engineers and Architects of Christiania, S. Eyde gave some interesting data on the nitric acid industry in Norway, based on the inventions of Birkeland and Eyde. So far twenty-two million kroner (a krone, plural, kroner, is the equivalent of 26.8 cents) have been invested in the establishments at Notodden and on the Rjukan River, which will be completed by the end of 1910, the total cost being estimated at fifty-four million kroner. The company has available in Norway waterfalls of 500,000 horsepower, with which it will be possible to manufacture 300,000 tons of nitric acid annually. This will require two factories of the size now being erected on the Rjukan, and they will not be ready for operation before the end of ten years and will require a total expenditure of 150,000,000 kroner. Chile at present exports 1,800,000 tons of saltpetre yearly, but competition is not feared, as the consumption of nitric acid is increasing so rapidly that the comparatively small amount which Norway will manufacture will not make itself felt in the world's markets. The works on the Rjukan will employ about 1,000 men. As regards the Notodden factory, the beginning of operations there was attended with unforeseen difficulties. Three months after opening, the generators were destroyed by fire due to constructional faults. The defects have now been overcome, and the machines have been working uninterruptedly for nine months. The first fiscal year has resulted in a net profit of one-half million kroner, with total receipts of 2,000,000 kroner, although it was possible to work with an average of only 13,000 kilowatts on account of the accident mentioned, while the total capacity of the plant is 22,000 kilowatts. The Norwegian company owning the Birkeland and Eyde patents has recently combined with the Badische Anilin & Sodafabrik, of Germany, which has been working in the same field, as it was considered difficult to obtain the enormous capital necessary for the enterprise in Norway alone. Two new companies have been formed, one of them being engaged in the development of the waterpowers and the other in the manufacture of nitric acid. Experiments now under way will determine whether the furnaces of the German concern or those of Birkeland and Eyde will be permanently adopted in the large establishment.—*Translated and abstracted from Zeitschrift für Elektrochemie (Halle), March 1.*

A 500,000-VOLT EXPERIMENTAL LINE.

A 500,000-volt experimental line established at the laboratory of Olav Ingebourg, Norrkoping, Sweden, is described by Kurt Brecht. The generator is a single-phase alternator driven by a 100-horsepower Diesel engine. The switchboard contains, besides the usual instruments, a Jona tension meter for 200,000 volts, higher pressures being calculated according to a specially prepared table. The transformer in use is of the core type, built after the model of the General Electric Company's 200,000-volt transformer. The insulation between high and low-tension windings consists of oil circulating in cylindrical channels of ebonite. The high-tension terminals are oil-filled micanite cylinders, closed by micanite discs, through which the wires are led, and which are mounted on marble plates on top of the transformer. The upper ends are sufficiently high to prevent discharges to the transformer cover; the lower parts extend to about 150 millimetres below the oil surface. The low-tension lines enter the transformer through porcelain bushings. Provision is made for utilizing the transformers, also for lower tensions than 500,000 volts. Two spark gaps indicate over-tensions, the apparatus is grounded by water jets and the primary winding is protected by over-tension relays. From the transformer the line passes over two

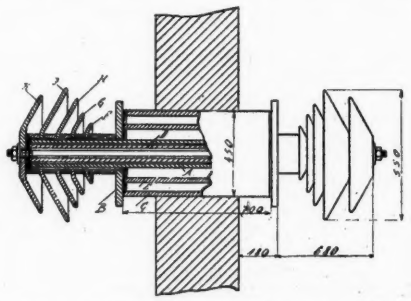


FIG. 1.—INSULATION THROUGH WALL.

large high-tension insulators provided with self-induction coils, which are connected to the secondary of the transformer. They serve for taking up the electrical vibrations generated by discharges and prevent them from being transmitted to the transformer. Then the line is led through the wall of the transformer room in the manner shown in Fig. 1. A number of porcelain cylinders are arranged concentrically, the largest one being 450 millimetres in diameter, and held in place by end plates of porcelain. Protecting bells are slipped over the projecting smaller tubes at each end. The tests made with this arrangement gave very good results. The line leaves the building through insulators of identical construction and is carried by iron masts eighteen metres in height for a distance of 2,500 metres. The line is situated about three kilometres from the coast and is therefore exposed to severe weather conditions. Insulators of different makes were thoroughly tested. There was no appreciable leak over a Locke sixteen-inch insulator at a tension of 100,000

volts and with water jets striking it from all sides. In rainy weather leakage was observed only at 275,000 volts. The line is carried by suspended-type insulators of seven units, the conductors being at a distance of three metres from each other. Both copper and aluminum were tested. A hemp net under the conductors served as a protection against their falling. Metal was not used in order to avoid discharge phenomena. Conductors of cross-sections from twenty to 250 square millimetres were employed in order to observe the difference in the surface discharge. A wire of ten square millimetres cross-section showed discharges at 35,000 volts, one of twenty square millimetres at 50,000 volts, one of 100 square millimetres at 200,000 volts, and one of 250 square millimetres at 390,000 volts. The tension was gradually raised from 100,000 to 480,000 volts. At the latter pressure the noise of the discharge was considerable and sparks issued from all parts of the conductor, insulator supports, etc. The electrostatic field in the vicinity of the line was so strong that brush discharges could be drawn from insulated conductors and vacuum tubes approached to the line lit up brightly. At night the glow of the line itself could be observed at a distance of four kilometres. With insulators carried by supports the experiments could be pushed only to a tension of 425,000 volts, but with suspended insulators of seven units arranged in the manner similar to that shown in Fig. 2, it was possible to carry out the tests at 500,000 volts without noteworthy disturbances. The experiments have demonstrated that an operating tension of 200,000 volts is possible even inside of buildings if good insulating materials are employed.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), March 11 and 18.*

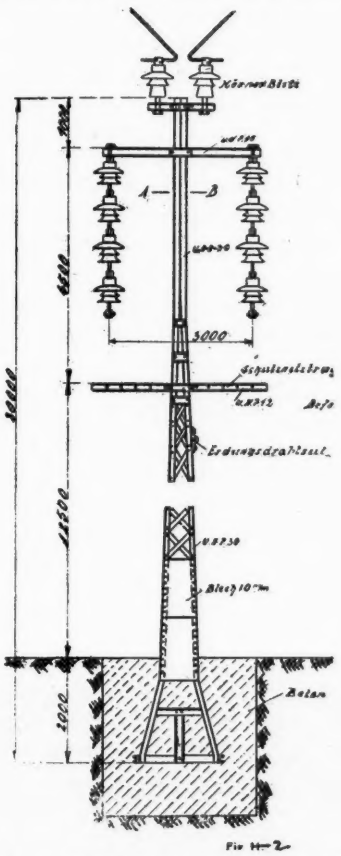


FIG. 2.—ELEVATION OF LINE POLE.

SYSTEMS OF CHARGING FOR ELECTRICAL ENERGY.

This is a very clear article upon the complicated subject of rates. Nine different rate systems are described in some detail and their advantages and shortcomings pointed out. The first is the well-known flat-rate system. The second is the straight meter plan. The third is described as a composite system, which has classified rates for domestic lighting and power service. The fourth system is that based upon the use of Wright maximum-demand meters; in this connection there are also pointed out methods of estimating the maximum demand without the use of a specific meter, and examples are given of the methods of calculating the net charges. The fifth system is that devised by Henry L. Doherty, in which consideration is given to the number of customers, their distance from the station, the capacity they demand, and the amount of their consumption. The sixth system is described as the Four C system, which derives its name from the fact that it consists of a capacity charge and a current charge. The double-rate meter method is described as the seventh system. In this but one meter is provided, and this meter has two dials, one of them automatically going into service during the peak-load period and the other operating during the remainder of the day. The eighth plan is one based upon the customer's minimum monthly guarantee. This has been recently devised by the Union Electric Light and Power Company, of St. Louis, Mo., and consists of a novel system of rates, which provide a sliding scale for different sizes of installations, and different guaranteed amounts of energy consumption per month. The ninth plan consists of combinations of the above systems that are suited for particular situations. Each of these plans is described with considerable clearness, so that one not versed in the subject may rapidly comprehend their details.—*Abstracted from the Engineering Magazine (New York), April, 1909.*

Hon. Charles A. Parsons Gives His Views on Turbines.

The Hon. Charles A. Parsons, inventor of the famous steam turbine that bears his name, arrived in this country a few days ago on the Mauretania, which ship, appropriately enough, is equipped with Parsons turbines.

In a recent interview Mr. Parsons declared that the present type of turbine is the very best that can now be made, and that the turbine is destined to supersede almost entirely the reciprocating engine. It is less liable to accident than the latter, and is a very perfect engine. Of the hundred or so turbine-propelled steamships now in existence, not one of them has broken down.

The cost of up-keep is fifteen or twenty per cent less than in the other type, and in the matter of coal consumption, that, of course, depends on the speed.

Mr. Parsons believes that the turbine is entirely adaptable to war vessels, and that they will be able to maneuver as well using this type as the other. All British warships of the future will be propelled by the turbine, and the trials in naval ships have been very successful. The new American Dreadnoughts, the Florida and Dakota, will have turbines.

One of the fastest vessels in the United States Navy, the scout cruiser Chester, is equipped with the Parsons turbine, and, Mr. Parsons predicted, will run away from the Salem in the special trial speed

Vessels of lower speed will operate under turbines at no greater expense than with the reciprocating type. The line of demarkation is about sixteen knots.

Mr. Parsons believes that the limit of size in steamships has about been reached with the Lusitania and Mauretania. With larger vessels the necessary depth of water is not to be obtained in the important harbors.

A New Radio-Active Substance.

A new radio-active product of the uranium series has been discovered by Jacques Danne of Paris. While engaged in the laboratory of Mme. Curie at the university in separating and concentrating the uranium X contained in sixty pounds of uranium nitrate, he was led to observe the new substance which appears as closely related to uranium X. He will call this body radio-uranium.—*Scientific American.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Factory and Plant of the Roller-Smith Company.

The new plant of the Roller-Smith Company of New York, about whom we had a notice in our last issue, contains many features of interest to the electrical trade. This company manufactures the highest grade types of circuit-breakers, electric-railway bond-testers, decade pattern bridges, direct and alternating-current instruments, both portable and switchboard types, ohmmeters, testing sets, and the like.

The factory, which is located at Bethlehem, Pa., consists of a two-story brick building with monitor roof, and a smaller one-story building.

The main factory building is arranged for general machine shop, tool room, woodworking room, grinding room, plating room and stock room on the first floor, with offices, drafting department, experimental department, circuit-breaker assembling department, instrument-assembling department and lavatories on the gallery. This gallery is twenty-five feet wide and extends around the entire shop, surrounding a light well under the monitor. The main floor is concrete, reinforced where necessary for heavy presses. The separate departments are divided one from another by fireproof partitions. The doors are ironclad and all interior windows are made of heavy wired glass.

On this floor power is divided into three units, driving the main machinery, the grinding and woodworking machinery, and furnishing current for plating and for charging the two 8,000-ampere storage-batteries which are used for testing both instruments and circuit-breakers. Power is furnished by the Lehigh Valley Transit Company from Allentown, both alternating and direct current being supplied.

THE NEW WORKS OF THE ROLLER-SMITH COMPANY, BETHLEHEM, PA.

On the gallery floor are separate power units for the finer machine work on circuit-breakers and for the precision lathes used in the manufacture of instruments.

Situated in the northwest corner of the main floor is a large modern woodworking department for the manufacture of instrument cases and cabinet work for all the different types.

Separated from the woodworking department by fireproof partitions is the finishing room, where the cases are finished ready for varnishing, this final operation being done in an adjoining room, which is also separated by fireproof partitions.

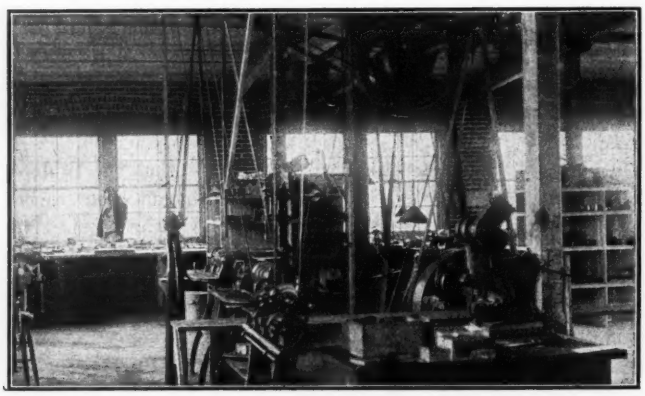
To the east of the carpenter shop is the grinding room in which all of the grinding and polishing of the metal parts is done. This room is, like the others, both fireproof and dustproof, and is properly equipped for the expulsion of all the dust from the grinding and polishing machines.

Directly east of the grinding room is a similar room in which is done the plating of the metal parts.

The stock room, including the shipping department, is situated in the southeast corner of the first floor. This is convenient to all parts of the shop and is designed for the speedy handling of outgoing and incoming material.

With the exception of the southwest corner of the lower floor, which is given over to a complete tool room operating in connection with the machine shop, the balance of this floor is used for the general machine shop, where the heavier parts of the circuit-breakers and instruments and tools are made and machined. On this floor also are the storage batteries and the boards for testing circuit-breakers, which may be directly calibrated up to 10,000 amperes.

The offices of the factory are situated at the head of the entrance stairs on the gallery floor. These consist of one general room and two private offices, the superintendent's office being so arranged that practically every point in the shop can be seen by him without his leaving his desk. Next to the offices is the drafting department, and adjoining it and a part of it the experimental department, where all the experimental work and designing are completed before the drawing is given to the shop for manufacture. It was the idea in making this arrangement that the drafting force be made a part of the experimental force, and vice versa, and no separation was made between the two



NORTH END OF CIRCUIT-BREAKER ASSEMBLY ROOM, ROLLER-SMITH COMPANY, BETHLEHEM, PA.

NORTH END OF INSTRUMENT ASSEMBLY ROOM, ROLLER-SMITH COMPANY, BETHLEHEM, PA.

departments in order that the freest of communication might be made at all times, thus allowing the fullest discussions by those working in these conjunctive lines.

Along the west and a part of the north sides of the gallery is carried on the manufacture of some of the smaller parts of instruments and circuit-breakers and also the assembly of circuit-breakers. On the north side are located the several precision and jewelers' lathes used in the manufacture of the finest parts of the instruments.

The entire east gallery which is separated from the rest of the shop by glass partitions is given to the assembling of instruments. This large room, which is directly lighted through three outside walls and from the monitors through the fourth, was designed particularly for this purpose and is entirely free from vibration. Extraordinary precautions were taken in building this department to make it as near dustproof as possible.

Just north of the main building and separated from it by a twelve-foot alleyway is the smaller one-story building, in which are the heating boilers, the blacksmith shop, the foundry, the pattern room and the enameling room.

Both buildings are heated by a vacuum steam system, steam being supplied by twin boilers manufactured and installed by the Messinger Manufacturing Company, Tatamy, Pa. These boilers are so arranged that they may be used in conjunction, or singly, as desired. In the same room with the boilers and on the same level are the four furnaces for the melting of the brass, aluminum and copper for castings. All the castings used in the circuit-breakers and motors, with the exception of the iron castings, are made by the company.

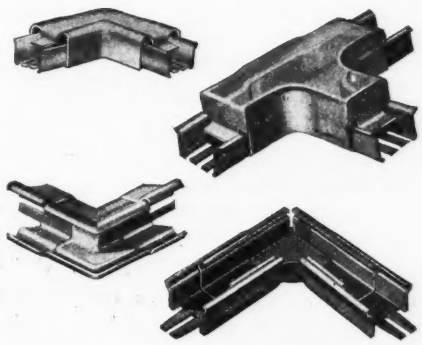
In this room also is the blacksmith shop, where the magnets used in the instruments are made. Joining the foundry room and connected therewith is the pattern room. Next to the pattern room, and separated from it by a solid fireproof wall, is the enameling room, which, because of the class of work, is as fireproof as modern methods can make it.

Both the main factory and foundry buildings are constructed on the unit plan, the east walls being so built that without in any way weakening the floor and roof they can be knocked down, it being the intention of the company to build on the east side of the present factory and continuing therewith a duplicate of the present shops.

Lutz Metal Molding.

The rebuilding of the plant of the American Circular Loom Company at Kenilworth, N. J., that was recently destroyed by fire, has enabled this company to renew the manufacture of Lutz metal molding under improved conditions. This molding has been used in a large number of installations, and provides, within a very small space, a complete and continuous raceway for electric wires with fittings for every detail of construction. It is easily installed with the minimum amount of labor.

EXAMPLES OF "LUTZ" METAL MOLDING.

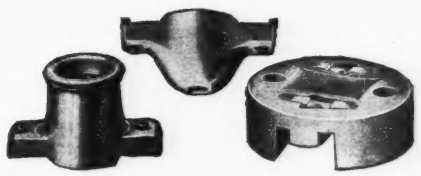


"LUTZ" RIGID AND ADJUSTABLE ELBOWS.

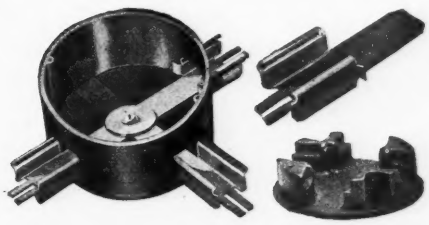
In construction, Lutz molding is very simple. It is made of electro-galvanized steel and consists of a channel-form base with grooved exterior flanges, into which, after the two wires or the twin wire are laid, flexible capping is readily slipped. This closes the raceway entirely and protects the wires as completely as if they were placed in pipe conduit. The capping can be easily removed, if at any time the wiring is to be changed or examined. The molding is made in ten-foot lengths joined by couplings or bonds with pronged ends that are bent to engage with slots cut in the base.

All the auxiliary fittings, such as elbows, tees, crosses, outlet and junction boxes, are similarly supplied with means for interlocking with the base. Fixture straps, rosettes, receptacles and switch bases are specially arranged to straddle and fit the base. Adapters are provided to connect Lutz metal molding with regular pipe conduit and with panel boards. They have recessed chambers to engage with the base and lugs to keep the capping from coming into contact with the wiring connections.

"LUTZ" ADAPTERS.



"LUTZ" PORCELAIN ROSETTES, RECEPTACLES AND SWITCH BASES.



"LUTZ" OUTLET BOXES.

"LUTZ" FIXTURE STRAPS.

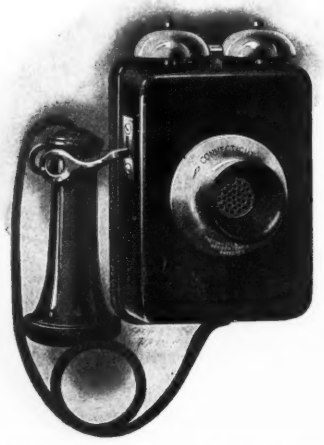
Balloon Wireless.

A. Leo Stevens, the aeronaut, will make an ascension shortly from the Springfield Aero Club at Springfield, Mass., with a balloon fitted out with a wireless telephone instrument. The instrument has been devised by A. Frederick Collins, of Newark, N. J., who has been experimenting with it for some years.

Mr. Stevens said that wireless stations will be installed at the top of some high buildings in New York and Boston, from which communication with the balloon will be established during its flight.

New All-Metal Box Telephone.

The Connecticut Telephone and Electric Company, of Meriden, Conn., has recently placed on the market a new type of all-metal telephone to be used in connection with its hotel, apartment and two-line interior telephone system. This telephone is designed principally for battery

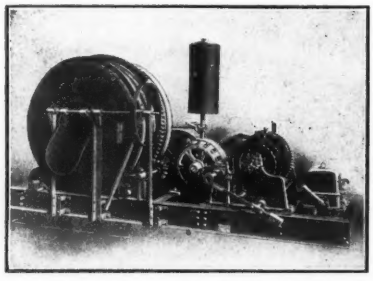


NEW METAL BOX TELEPHONE.

call service, but it can also be arranged for common-battery exchange service. The telephone is equipped throughout with the best long-distance parts, and all cord and line connections are made inside the case. It is finished in black enamel with nickel trimmings, making a handsome and neat appearance entirely in keeping with this class of service.

A Motor-Driven Concrete Mixer.

The concrete mixer forthwith described was designed for the Ransome Concrete Company by C. G. Meyers, of Norman B. Livermore & Company, San Francisco,



MOTOR-DRIVEN CONCRETE MIXER.

Cal., to meet the requirements of heavy continuous service. As shown in the illustration, the concrete machine consists of a No. 2, 1908 model, special combination Ransome concrete mixer mounted on a ten inch steel I-beam frame. On the end opposite the mixer is mounted a Mead-Morrison single-drum hoist. Both mixer and hoist are arranged to be driven directly through gearing by a thirty-horsepower type "CCL" Westinghouse alternating-current motor operating at 850 revolutions per minute on 200-volt, sixty-cycle, three-phase current and equipped with the necessary auto-starter. The mixer is provided with a Ransome patent water-measuring device and a No. 2 Ransome measuring hopper. .

A notable test of this installation was recently made in Sacramento, Cal., where it is being used in the erection of a reinforced concrete hotel building at the corner of Tenth and K streets, when 381 cubic yards of concrete were placed in less than nine hours. This involved the mixing of 315 cubic yards of rock, 158 cubic yards of sand and 572 barrels of cement, a total of 551 cubic yards of loose dry material which weighed in the aggregate 1,427,000 pounds. The addition to this dry material of 460 barrels of water brings the actual weight of material handled to 1,547,600 pounds.

Transformer for Moving-Picture Arc Lamps.

The problem of supplying low-voltage alternating current to moving-picture arc lamps from commercial-supply circuits has several solutions. These involve either the use of a rheostat or a choke coil in series with the arc, a compensator or auto-transformer connected across the line with low-voltage taps or a transformer with a low-voltage secondary.

It is a well-known fact that there is a very large waste of energy in a series rheostat, depending, of course, upon the voltage of the supply circuit. Many lighting companies require the use of 220 volts for moving-picture work, in order to avoid heavily loading one side of a three-wire system. This increases the losses considerably in circuits where a resistance or a reactive device is used for reducing the voltage.

The use of a rheostat also involves a greater fire risk, due to excessive heating. It also increases the discomfort and danger to the operator. Another disadvantage is the effect produced on the voltage regulation of the lighting circuit when the lamp is switched on or off.

Reducing voltage by the use of a choke coil or an auto-transformer is undesirable on account of the introduction of reactance into the circuit, resulting in a large current at a low power-factor being taken from the system, thereby seriously affecting the voltage of the lighting circuit. This scheme is also open to the objection that the operator may receive unpleasant shocks when the circuit is suddenly opened or closed.

In order to meet the demand for a device that would be free from all these objectionable features, the General Electric Company, Schenectady, N. Y., has recently placed on the market a special transformer for moving-picture work. This transformer, known as the "Economy-Arc," has a low-voltage secondary winding, with three taps giving thirty, forty or fifty amperes in the arc circuit. This method of regulating the current is a valuable feature of the "Economy-Arc" and adapts it to a number of varying conditions, such as result from different densities of films and different distances between lamp and screen. The fact that with this device there is no direct electrical connection between the lamp and the supply circuit is also important.

The transformer is so designed that with the secondary on short-circuit, the

ARC LAMP TRANSFORMER FOR MOVING-PICTURE MACHINES.

primary current will not rise to an excessively high value. The temperature rise being low, the "Economy-Arc" is very cool-running, and its introduction to the circuit increases the reactance but little.

Frink's Tubelite.

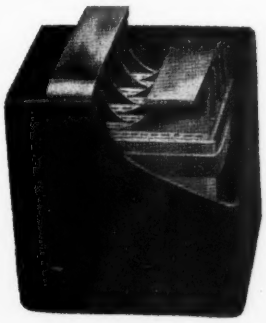
The firm of I. P. Frink, 551 Pearl Street, New York city, has brought out a reflector for illuminating show windows, showcases, or any other thing or place where light is needed, which occupies only a two-and-one-quarter-inch space. It can be made in any length up to ten feet, without seams, and can be finished in any color desired. Another prime feature of the Tubelite is that standard-base tubular lamps are used. These lamps can be purchased in any electrical supply store, and if a lamp burns out there will be only a six-inch unlighted space. Illumination from eight to sixty-four candlepower per foot will be obtained, according to the lamps used.

Standard Electric Accumulators.

A storage battery of somewhat novel construction has been meeting with considerable favor recently. The S. E. A. cell is a departure from the established practice of accumulator construction, as it provides an electrode in which the active material is boxed up, being so held in contact with its lead backing as to

FIG. 1.—SECTION THROUGH STANDARD ELECTRIC ACCUMULATOR PLATES.

eliminate buckling and disintegration. The result is a cell which has all the good qualities of the ordinary lead accumulator with a wide margin of indestructibility under severe conditions. A single plate of the S. E. A. cell is composed of a lead conducting plate sandwiched between two porous earthenware plates. These plates, of which the inner surfaces are reticu-



S. E. A. CELL.

lated to grip the active material and the outer surfaces ribbed for strength and to furnish flues for the circulation of electrolyte, are converted into thin tight boxes by conductive plates, as shown in Fig. 1, which absolutely prevent the escape of the active material. The earthenware plates are so porous as to offer no material obstruction to electrolytic action while preventing completely loosening, escape or infiltration of the active material.

The result is a cell identical chemically with other lead-lead-oxide cells, but very light for its rating on account of the absence of heavy retaining grids. Cells of this type in use for as much as five years are said to be still in as good condition as when first put together, and apparently are good for many years more of regular service. Cells of 100 ampere-hours' rating sealed in rubber jars with electrolyte can be brought down to a scant twenty pounds in weight, it is claimed, without difficulty or increased risk.

The unit system is employed in the construction, the individual boxes being 3.5 inches square by 0.5 inch thick and weighing 10.6 ounces with a capacity of two-and-one-half ampere-hours. In building up elements, as many of these as are necessary to secure the desired output are assembled, as shown in Fig. 2. This construction gives a considerable choice as to the relative proportions of elements, which is sometimes very convenient.

Repeated tests of the S. E. A. cells have shown excellent efficiency and the same immunity from deterioration in practice that would be expected from theory. Tests recently made show a capacity of 12.5 per cent more than the rated capacity. Even severe short-circuiting does no permanent damage and the cell thus treated can promptly be brought back to its full capacity.

One considerable advantage of the S. E. A. construction is that the active material can be disposed in a thin layer without fear of disintegration, which promotes uniform chemical action and lessens the chance of forming local circuits.

The S. E. A. plates when examined after long use are said to show the active material remarkably coherent and homogeneous with no signs of local action. Further advantages of the S. E. A. batteries are claimed in that they need no repairs in the form of renewal of plates or any other parts, and they need no cleaning, as no disintegration material assembles at the bottom of the jars, which amounts to considerable saving annually on the cost of maintenance.

The weight of cells for electric vehicles complete with rubber jar, electrolyte and connections for various sizes is:

Capacity.	Weight.
21 amperes for 4 hours	19 lbs.
35 amperes for 4 hours	33 lbs.
42 amperes for 4 hours	39 lbs.

The weight of an automobile battery consisting of forty-two cells giving a thirty-five ampere discharge for four hours is 1,638 pounds.

The S. E. A. accumulator is manufactured in all the usual sizes and put up in sealed rubber jars, glass cells or lead-lined wooden tanks as occasion demands, and the unit system of construction makes it easy to develop cells of special weight or capacities. This battery is made by the Standard Electric Accumulator Company of New Jersey, having offices and factory at 91 and 93 Mercer Street, New York City. The agents for the western territory are F. B. Badt & Company, 1505 Monadnock Block, Chicago.

Demonstration of Electric Drive for Textile Machinery.

At the coming Textile Exhibition, to be held in connection with the convention of the National Cotton Manufacturers' Association, at Boston, April 26 to May 1, the Westinghouse Electric and Manufacturing Company will present a practical exhibit of its electric motors and apparatus especially designed for the operation of textile machinery. The exhibit will illustrate the application of motor drive to this class of work, as well as the development of an extensive and specialized line of apparatus designed for the exacting needs of this service.

Spinning-frame motors will be shown, complete and in sections, and a similar display will be made of loom motors. The Westinghouse type F motor, which is applicable especially to group drives, will also be exhibited in several larger sizes. All of the apparatus will be supplied with a full equipment of control and protective devices, including spinning frame and loom switches and circuit-breakers.

Test of Lubricating Grease on Electric Railway Car.

The Keystone Lubricating Company of Philadelphia announces the result of a test of its pure mineral lubricating grease on an electric car of the Providence & Fall River Interurban Railway.

A two-motor car was supplied with a twenty-five pound charge of Keystone motor grease for the motor and axle bearings at one end and an equal quantity of the ordinary stock grease hitherto used by the road at the other end.

On the car being put into regular service it was found at the end of the trial that less than one-third of the Keystone grease had been consumed, while two-thirds of an additional charge of the stock grease, as well as the whole of the original charge of twenty-five pounds, had been used.

Electric Drive in Printing Plant.

One of the oldest and largest printing establishments in the state of Texas, that of Clarke & Courts, Galveston, has just completed the electrification of its drives. The order for twenty-one motors, recently placed with the Birmingham office of the Crocker-Wheeler Company, makes a total of sixty-one Crocker-Wheeler motors in this plant. The motors just ordered are for the following purposes:

A ten-horsepower motor for driving the elevator; two three-horsepower and a two-horsepower motor driving cutters; a one-horsepower, driving a group of numbering machines, and a one-horsepower, driving a group of wire stitchers; a one-half-horsepower, driving a box machine, and a similar motor, driving a punch; eight one-fifth-horsepower motors driving ruling machines, and a one-fourth-horsepower, driving a sewing machine. In the electrotype shop there are two five-horsepower motors driving groups of machinery, a one-horsepower motor, driving a black-leading machine, and a three-horsepower, driving a plating dynamo.

This plant covers a whole block and is four stories high.

British Aluminum Company.

The British Aluminum Company has put in operation its power scheme at Kinlochleven, on which over $5,000,000 has been spent, and begun production there, six months earlier than first intended. This haste, the company informed shareholders, is due to dissolution of the pool in aluminum September 30, last, resulting in a drop in prices from $1,000 a ton in 1907 to $300 a ton; this will cause the company to rely on greatly increased sales rather than high profits. The company will issue $1,200,000 debentures of a subsidiary and increase its own $500,000 five per cent debentures to $5,500,000. It plans eventually to produce 30,000,000 pounds of aluminum annually.

Wireless Telephone and Telegraph Company to Build Additional Manufacturing Plant.

The Radio-Telephone Company has taken over factory space at Newark, N. J., for the manufacture of wireless telephone and telegraph apparatus. The plant, which will be for the most part electrically driven, has been designed by Roscoe Kent, chief engineer of the company, and will occupy 5,000 feet of floor space. In addition, a structure will be built on the roof for experimental research and development work.

Central Electric Time Switch.

The use of time switches is rapidly increasing as their various applications become generally known. These conditions have created the demand for a simpler or less complicated device than has frequently been secured in the past. To meet the demand for a reasonably priced switch having a capacity up to and including thirty-five amperes, the type shown herewith has been developed, and is being marketed by the Central Electric Company of Chicago, Ill.

The switch mechanism is of the well-known double-pole type and so located as to be operated by means of a tripping mechanism controlled by a standard clock. To operate the device it is only necessary to close the switch and set the clock at any hour it is desired to have the switch opened. At this predetermined time the

CENTRAL ELECTRIC TIME SWITCH.

clock releases the locking toggle and the switch is instantly thrown open by a suitable controlling spring.

Time switches have been found especially useful in connection with the sale of current on a flat-rate basis, that is, where lamps are to be switched on or off at definite hours on a fixed charge for current. Current for tungsten lamps is being sold on this basis in many cities.

In stores and apartment houses the use of time switches not only effects a great saving in current used, but what is often more important, assures punctual service that attendants will not give. In small stores it often happens that everyone is busy at the time when the lights should be turned on. In apartment houses the halls are frequently dark through forgetfulness or absence of the janitor. With a time switch the lights are always on and off at the right time.

When show windows or signs are located near theaters or other places of amusement it is very desirable to have them illuminated while the crowds are passing. The time switch can be set to turn the lights off at any desired time, and makes a trip to the store unnecessary.

The time switch can also be successfully used in public or private illuminating plants for controlling service at a flat rate during specified hours. There are many other situations where it can be used for convenience and profit as, for instance, in charging automobiles or storage batteries of any kind and in every place where the current should be turned on and off at definite hours.

The Excess Indicator.

A paper by A. T. Holbrook, entitled "A Treatise on Newer and More Positive Methods of Charging for Electrical Current," was to have been read at the recent meeting of the New England Association of Electric Lighting Engineers, but was crowded out by the volume of other business.

The paper contained an account of a unique device called the Excess Indicator, which is manufactured by the Excess Indicator Company, Lynn, Mass.

The operation of the instrument is to open and close the main circuit whenever the lamps under contract have been exceeded. This flickers the lamp until the excess is turned off. This flickering will continue indefinitely and is so annoying that the customer will use every reasonable means to stop it, and soon learns that he alone suffers if he fails to keep his agreement. The range of the adjustment of the instrument is very great considering the delicacy of its operation. It will operate equally well on a load of from one-half to ten amperes, and the adjustment can be made within ten per cent of any predetermined demand.

Wireless Activity on the Great Lakes.

A great steel wireless tower will soon be erected on the Hippodrome Building in Cleveland, Ohio, as the transmitting and receiving station for wireless messages over all the Great Lakes. The Great Lakes Radio Telephone Company, a subsidiary concern of the Radio Telephone Company, will run this station and has leased the entire front of the tenth floor of the building for its general offices. Cleveland was chosen for the headquarters on account of its central location.

It is proposed to have seventy-five stations in operation along the Great Lakes before this coming summer.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, April 3.—So far as the revocation clause of the new patents act is concerned, the greatest activity up to the present has been shown in regard to electrical patents, for, in addition to the revocation of the Bremer arc-lamp patent, other actions in regard to different classes of electrical machinery are pending. It is of interest, also, to mention that there is a possibility of the rules under which revocations are applied for being drastically amended in favor of the patentee.

It will be remembered that soon after C. H. Merz had sent in his report upon the conversion of the Melbourne railways to electric traction, the Railway Commissioners on the spot issued a counter report in which they differed from Mr. Merz' conclusions and doubted whether his predictions were likely to come out all right. Mr. Merz has now replied to this report by stoutly defending his original report and sticking to his estimates.

A special appeal has been made to the electrical industry here in order to give an impetus to the electrical trades benevolent institution, which has been in existence since 1903, but which has not been pushed with any very great energy. However, leading men in the industry have now taken the matter up, and from various sources a sum amounting to about $12,500 has been subscribed. The object of the fund is to assist electrical workers between the grades of workmen and masters, who have fallen on evil days, a preference being given to those who are subscribers, although no rule to this effect is in existence.

The London County Council is to make an application to the Board of Trade for permission to run trailer cars for passenger service in the early morning and in the evening. The Highways Committee points out that such cars are largely used in the United States and on the Continent and they feel that the use of trailers for this purpose in London would be particularly useful. It is proposed to have single-deck cars attached to other cars. The control would be such that, while the motors and magnetic gear of the leading car would be manually controlled in the ordinary way, those of the rear car could be controlled by electromagnetically operated switches or contactors.

Some discussion is taking place concerning the decision of the Glasgow Corporation to accept the tender of the Lorain Steel Company for special tramway trackwork, spare points, steel rails and fishplates. There was a marked difference between the tender accepted and those of the lowest British firms, and it is claimed that, as it is not a case of dumping but of special work in every case, there must be something wrong somewhere. As an example of the difference in the prices, it may be mentioned that, whereas the Lorain Steel Company will supply fishplates at $30 per ton, the lowest tender from a British firm was $60. On this question of foreign competition, it is interesting to note that of the sixteen tenders received by the Darlington Corporation for an exhaust steam turbine, the highest was from a German firm. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, APRIL 3.—Barcelona is to receive a supply of current from a 16,000-horsepower turbine plant, located on the river Tel, and fifty-five miles from the city. A high-tension power line working at 54,000 volts will run from the station to Barcelona, where a large substation is to be erected. The cost of the undertaking is estimated at $2,000,000.

An electric-lighting plant is to be erected at Rion-des-Landes. The municipality of Florac is considering an electric-lighting project, as is also the town of Decize. Plans are being drawn up for an electric-lighting project for the communes of Alise, Venarey and Laumes. The town of Bethune is to grant a concession for an electric plant. For the large town of Autun there will probably be erected a station of some size by the Epinac colliery firm. It will operate power lines for this region, in which there is a considerable field for motors in the industries.

A syndicate has been lately formed for operating platinum mines in the Ural district of Russia. Local firms are interested in it and also the French Bonardelle firm.

According to the recent report of the Felten and Guilleaume Cable Company of Vienna, the net profits for the fiscal year are 2,283,405 crowns, which is a slight increase over the last year (2,259,669). A report of the Vienna Cable and Wire company shows a gross profit of 2,126,100 crowns, against 1,956,029 crowns for the preceding year. The Pressburg Cable Works has a gross profit of 966,898 crowns for the fiscal year. A. DE C.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

GREAT EASTERN TELEPHONE COMPANY GREATLY INCREASES ITS STOCK—At a recent special meeting of the Great Eastern Telephone Company held in New York city, the capital of the company was increased from $1,000,000 to $50,000,000.

POWER PLANT FOR COLORADO—Capital has been secured for the construction of a big power plant and reservoir in the Plateau Valley, in Colorado, to be known as the Meadows Reservoir and to generate a minimum of 8,000 horsepower. The big plant will furnish power for lighting the little towns of the plateau and power for the carrying on of a large number of large irrigation projects and pumping plants. Local men and eastern capital are behind the project. Work of construction starts within a few weeks.

LIGHT AND POWER COMPANY FOR PORTLAND, ORE.—The Oregon Light and Power Company has been organized by H. H. Riddell, A. E. Murphy and N. L. Bailey, all of Portland, Ore., with a capital of $2,000,000, to furnish electric light and power to Portland and the surrounding district. One million dollars will be expended for buildings and equipment, and it is expected the plant will be ready for operation within eighteen months. The remainder of the authorized capitalization will be used in maintenance and for a reserve fund.

HYDROELECTRIC PLANT ON THE ST. LAWRENCE—The directors of the New York & Ontario Power Company have decided to sell $1,850,000 bonds, the proceeds of which are to be used in developing waterpower at Waddington, N. Y. The cost of harnessing the St. Lawrence River and equipping the power station is placed at $2,000,000. Work on the improvement is to be begun this spring. The company has the right to sell power in both Canada and the United States and will furnish electric energy for the operation of the new Norwood & St. Lawrence Railroad.

BIG MERGER OF ELECTRIC CORPORATIONS IN WASHINGTON STATE—With a capitalization of $80,000,000, the Puget Sound Power Company has been incorporated as a holding company to take over all the electric-light, power and street railway systems to the northwestern part of Washington. Besides holding existing plants and properties, it is the intention to continue interurban and power extensions now planned and promote further extensions that will culminate in a continuous line of interurban rails from Vancouver in British Columbia to Portland, in Oregon, with a service to the Grays Harbor towns.

FURTHER ELECTRIFICATION OF THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD—Plans have been completed for the electrification of the New York, New Haven & Hartford from Stamford, Conn., to New Haven, continuing the line now electrified from New York to Stamford. Work will be begun at once on a power house on the Housatonic River at Naugatuck junction on the main line. The new power house which will supply electricity will be on the water front, so that coal and other supplies can come by water. In two years all passenger trains between New York and New Haven will use electricity. The New Haven electrical experts are unanimous in their opinion that the electrical operation between New York and Stamford is a success. The shore line division will be equipped to Boston as soon as possible after the work to New Haven is completed.

LIGHTING AND POWER

(Special Correspondence.)

CLAFLIN, KAN.—E. R. Ruch is to install a $5,000 electric-light plant here.

NASHVILLE, ARK.—A. H. Bunch is to establish an electric-light plant in this place.

KIOWA, OKLA.—This city has voted light and water bonds to the amount of $31,000.

PHILADELPHIA, PA.—The annual meeting of the Philadelphia Company will be held May 3.

OKEMAH, OKLA.—This city has voted bonds to the amount of $5,500 for an electric-light plant.

LEHIGH, OKLA.—This city has voted $12,500 in bonds for the construction of an electric-light plant.

MONTEZUMA, IA.—The Montezuma Electric Light, Power and Heating Company has been incorporated with a capital of $6,000.

SAN ANTONIO, TEX.—The San Antonio Gas and Electric Company will put in a power plant to cost $125,000.

WALTER, OKLA.—This city has voted a twenty-year electric-light franchise to the O'Neal Electrical Company.

RED LAKE FALLS, MINN.—The Red Lake Falls Electric Light Company has applied for a thirty-five-year franchise. C.

OAKVILLE, WASH.—A. K. Bowes and S. A. Wells have applied for an electric-light and power franchise in this city.

SUNNYSIDE, WASH.—Robert Strahern has been granted a franchise to construct an electric-light system in this city.

COLUMBUS, OHIO—The Cleveland Electric Illuminating Company has increased its capital from $5,000,000 to $6,500,000.

PRESCOTT, WIS.—The Prescott Light and Power Company has purchased a site for the erection of an office building and substation. C.

RED BLUFF, CAL.—The Sierra Electric Power Company has applied for a fifty-year franchise to erect electric power lines in this vicinity.

VOLLMER, IDAHO—The trustees of this city have taken over the electric-light plant and will expend upward of $4,000 in improvements.

GUAYMAS, STATE OF SONORA, MEXICO—A hydroelectric plant is to be installed by W. O. Temple on the Mayo River, this state. D.

LAWRENCE, KAN.—Articles of incorporation have been drawn up for the Lawrence Light and Railway Company, with a capital of $500,000.

LEWISTON, MONT.—Sam W. Gebo has applied for an electric-lighting franchise in this city. He proposes building an electric plant here shortly.

ROUNDUP, MONT.—The city having been incorporated, work on the electric-light plant will be rushed and it is hoped to have lights furnished by May 1. C.

SAVANNAH, GA.—The Savannah Electric Company is contemplating the installation of a 1,000-kilowatt steam turbine in addition to its present equipment.

KLAMATH FALLS, CAL.—The Klamath Falls Light and Power Company has been granted a five-year franchise to maintain electric power lines in this vicinity.

DOWNEY, CAL.—Col. J. R. Gordon, owner of an electric-light plant in this city, proposes to extend lines to Rivers, Norwalk and Artesia as soon as possible. A.

READING, PA.—The Reading Power Company has been merged into the Metropolitan Electric Company at a recent joint meeting of stockholders of the two companies.

SAN ANSELMO, CAL.—The Pacific Gas and Electric Company has been awarded a five-year contract to supply this municipality with electric lights for $2,500 per year. A.

SPOKANE, WASH.—The Trenwook Water and Power Company has been incorporated here, with a capital stock of $12,000, by P. H. Henshaw, H. McNeill, F. Walton and H. Pattison.

PALO ALTO, CAL.—An election has been called by the City Trustees to decide on the question of issuing bonds to the amount of $50,000, including $500 for a street lighting plant.

SANTA CRUZ, CAL.—Manager W. W. Coleman, of the Coast Counties Electric Light and Power Company, announces that extension work on the company's power lines will begin this summer.

WHITEFISH, MONT.—The Big Bend Light and Power Company has entered into a contract with the Flathead Water Power Company to furnish the Whitefish lighting plant with electricity. C.

OGDEN CITY, UTAH—The Telluride Power and Transmission Company will change from a single circuit to a double circuit, and will replace its wooden poles by steel towers, all within the next two years.

DOUGLASVILLE, GA.—It has been decided by an overwhelming popular vote that the town should issue $10,000 electric-light bonds for a municipal plant rather than give the franchise to a private company.

COLUMBUS, IND.—The Central Indiana Lighting Company, owner of the local street-car system and electric-lighting plant, has procured a site on White River on which to build and equip a new power plant this spring. S.

BUFFALO, N. Y.—Plans for a 2,500,000-candlepower searchlight to illuminate the Niagara Falls have been proposed by W. D'A. Ryan, chief illuminating engineer of the General Electric Company, and accepted. The lighting will be permanent and will probably cost about $35,000. Members of the committee have pledged subscriptions and efforts will be made to secure financial aid from the railroads.

TULSA, OKLA.—The Waynoka Electric Light and Power Company, of Waynoka, has been recently organized, with a capital stock of $25,000; incorporators, Grant Miller, Arthur L. Miller, George D. Miller, all of Waynoka.

SAN FRANCISCO, CAL.—The Smith River Electric Company has been incorporated here, with a capital stock of $250,000, by D. C. Demarest, E. C. Hegler, S. Harris, C. M. Lindsay, W. P. Swart, A. V. Massy and Carl Senn.

SAN FRANCISCO, CAL.—Plans are now ready for the installation of the new electric power plant in the United States Mint. Director Frank A. Leach arrived last week from Washington, D. C., to superintend the work. A.

WOONSOCKET, R. I.—Electric power is to supplant the steam and gas engines at the new mill of the Woonsocket Machine and Press Company. Three motors, with a total of 110 horsepower, have already been installed.

SOUTH BEND, IND.—The Manufacturers' Utility Company has incorporated to acquire sites and build waterpower electric plants and furnish manufacturers floor space and power. R. U. Miller, A. Nelson and J. Thomas, directors. C.

DURANGO, STATE OF DURANGO, MEXICO—A concession has been granted to David John Pullinger for the construction of a dam on the Presa River. The dam will furnish 2,000-horsepower for a hydroelectric plant which he will install. D.

YORK, PA.—Capitalists, headed by C. C. Spahr, are planning the erection of a $25,000 electric power plant at the Pickett. The power will be furnished for the operation of industrial plants and the lighting of buildings at Wellsville and other points.

WAKEFIELD, MASS.—This town has decided not to purchase electric current of the Malden Electric Company, as recently proposed, or of any other corporation or plant, but to continue municipal ownership and operation of its own works.

SPOKANE, WASH.—The Spokane-Orient Power Company has been incorporated here with a capital stock of $1,000,000 by C. A. Luncheford, C. H. Patten and A. R. Patten. A water right on Boulder Creek capable of developing 2,500 horsepower has been secured.

EUGENE, ORE.—The Eugene Light and Power Company has been incorporated here, with a capital stock of $300,000, by Frank L. Chambers, Darwin Barstow and Ray Goodrich. A site has been secured, with a twelve-foot fall, capable of developing 2,000 horsepower.

REDDING, CAL.—The electric power plant of the Bonanza King Mining Company was entirely destroyed by fire early last week. The loss is $65,000, and no insurance was carried. The capacity of the plant was 6,000 horsepower. It will be rebuilt immediately.

IOWA CITY, IOWA—The Iowa City Electric Light Company has a force of workmen busy with preparations for the installation of the new magnetite lighting system, which must be completed by June 1, at which time the new contract of city lighting goes into effect.

FRESNO, CAL.—The Sierra Park Electric Company has been incorporated here, with a capital stock of $100,000, by C. K. Kirby, J. W. McLaughlin, C. K. Kirby, Jr., F. K. Kirby and D. C. McLaughlin. An electric power plant will be built near the headwaters of the San Joaquin River.

RICHMOND, VA.—The sale of the Virginia Passenger and Power Company holdings in and about Richmond will take place the first week in May after being advertised four weeks in Richmond, New York and other papers, according to the terms of the decree of sale recently rendered. L.

LINTON, IND.—A company has been organized to purchase and take over the Linton municipal lighting plant. It is said the new company will erect a new plant a few miles from the city near a coal mine, and will furnish electricity to Linton and other towns and cities in the territory. S.

RICHMOND, VA.—Proposals for bids on the building of the municipal electric-light and power plant were approved by the council committee on electricity last night and the necessary advertising was authorized. The bids will be opened April 26. Engineer Trafford, who drew the plans, will supply the specifications to bidders.

BAY CITY, MICH.—Reorganization of the Sault Ste. Marie Gas and Electric Company is announced. The deal was pushed through by F. W. Little, a capitalist of Minneapolis. He is authority for the statement that at least $25,000 will be spent for improvements this year. All the obligations of the old company have been taken care of.

TOLEDO, OHIO—The property of the People's Gas and Electric Company at Defiance, Ohio, including electric-light, power and gas plants and several residence properties were sold April 8 at a receiver's sale to H. H. Parsons of East Aurora, N. Y., representing a group of bondholders, for $81,475, two-thirds of the appraisement. It is said that it is the intention of the company to expend about $35,000 on the plant if the franchise which expires in October is renewed. H.

ELECTRIC RAILWAYS.

(Special Correspondence.)

COLUMBUS, O.—The Ohio Northern Electric Railway Company has been incorporated with a capital of $50,000.

CARLISLE, PA.—The City Council has granted a perpetual trolley franchise to the Cumberland Railway Company, which is to pay the city $50 a year.

ST. JOSEPH, MISS.—The Blue Valley Traction Company, of Kansas City, has incorporated, with a capital of $300,000, to build and operate a railway from Raytown to Kansas City.

MINNEAPOLIS, MINN.—The Anoka-Minneapolis Suburban Railway Promotion Company has been incorporated to construct a trolley line between the two cities. The capital is $50,000.

BERKELEY, CAL.—The San Francisco, Oakland & San Jose Railway Company contemplates spending $3,000,000 on the extension of the Key Route line to the new town of Ocean View.

ATLANTA, GA.—The electric railway between Fairburn and Atlanta is now an assured fact. All of the money was subscribed several days ago and is now being paid into the treasury.

PORTLAND, ORE.—According to its official budget, the Portland Railway, Light and Power Company will spend this year more than $2,500,000 above its operating expenses in improvements and extensions.

WHEELING, W. VA.—A charter has been issued to the Rapid Transit Railway, capitalized at $1,000,000, to operate a line from this city, through the Reymann Hill to Patterson, and return through other suburban towns.

DANVILLE, IND.—The final survey is being made by the Terre Haute, Indianapolis & Eastern Traction Company for an extension of its system from this city to Clay City, Spencer, Cloverdale, Stilesville, Amo and Sullivan. S.

STOCKTON, CAL.—Vice-president Morris L. Brackett, of the San Joaquin Valley Electric Railway Company, has left for New York to sign bonds to the amount of $500,000 for the construction of the new interurban road to Modesto.

MICHIGAN CITY, IND.—A deal has been consummated whereby the electric lines in this vicinity, with the exception of the South Shore route, will use power exclusively provided by dams in the St. Joseph River, according to announcement from South Bend.

SAN JOSE, CAL.—An electric railway is to be built from Monterey to Vista Del Rey, Del Monte Heights and the Hot Spring tract. The preliminary survey is now being made, and inside of a few days the actual construction of the railway will be on in full blast.

KANSAS CITY, MO.—The people of Moberly and Huntsville have accepted a proposition made by Messrs. Manning and Wellman of Ottumwa, Iowa, to construct an electric street-railway line in Moberly, and an interurban line between Moberly and Huntsville, to cost $100,000. Moberly is to give a bonus of $30,000.

STERLING, ILL.—An interurban railway company has been incorporated at Springfield by men from Elgin and Sycamore made up of B. C. Payne, F. N. Rogers, E. S. Bailey, F. J. Hohing and F. W. Merrick with a capitalization of $100,000. It is stated that they contemplate the construction of an interurban electric line from Elgin to Sycamore, DeKalb and west to Dixon.

ANACORTES, WASH.—One of the most important features in the commercial development of the city and county will be the construction this summer of the Anacortes, Sedro-Woolley & Eastern Electric Railway, with terminals in this city and Sedro-Woolley. Practically all the preliminary work has been finished and it is expected that construction will be commenced within a few weeks.

SCRANTON, PA.—Between $200,000 and $300,000 is to be expended by the Scranton Traction Company this spring and summer in the general improvement of its system. This includes a gradual change in various lines, the double-tracking of a number of thoroughfares, the installing of a number of new switches and the completion of the new power house, the work of which is now well under way.

NEW YORK CITY—President Winter, of the Brooklyn Rapid Transit Company, has notified the Public Service Commission that as a result of the investigation undertaken about a year ago by the Public Service Commission on the subject of brakes on the elevated lines of the Brooklyn Rapid Transit, the company has made a contract with the Westinghouse Traction Brake Company for the installation of the Westinghouse system on the elevated railroad cars of the company.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad made a pronounced success with its second annual "Fruit Special." This demonstration train made a trip lasting over three days through the Palouse country and Spokane Valley. An exhibit car was in charge of Prof. O. M. Olson. Spraying and pruning demonstrations were made by Profs. A. L. Milander and W. S. Thornber. Lectures were given by Profs. R. W. Thatcher, H. T. French and J. R. Shinn on "Fertilizing the Orchard," "What the Experiment Station Can Do for the Orchardist" and "The Planting and Care of Fruits." The lecturers and demonstrators are connected with the Washington State College and the University of Idaho. Beginning with the meeting at Colfax on March 31, twenty stops were made, each of which attracted large crowds. The last demonstration was made at Palouse on April 3. These annual trips are proving very beneficial to the development of the adjacent country and, therefore, to the Inland Empire traction system.

TOLEDO, OHIO—New limited cars will be placed in service on the Ohio Electric between Toledo and Lima, Sunday, April 18. The cars are now in the barns of the company at Bellefontaine. On the same day the Ohio Electric will establish a limited service between Lima and Columbus, which is preliminary to a Toledo-Columbus electric route to be established in the near future. The Ohio Electric has established its Toledo terminal at Avondale Avenue temporarily. H.

OAKLAND, CAL.—The Southern Pacific Company is about to begin work on the electrification of its suburban roads. Surveyors have been at work for the past few days setting stakes at Melrose Station, the terminus of one of the company's lines, marking the route which the new electric extension will take through Melrose Heights. Orders were given a few days ago to widen the tracks on Shattuck Avenue, Berkeley, preparatory to converting that road into an electric system. The electrification of the Alameda lines is being pushed.

MILWAUKEE, WIS.—An ordinance granting a franchise to the Milwaukee Western Electric Railway Company was introduced in the Common Council by Ald. John Koerner, chairman of the committee on railroads, and referred to the committee on railroads. Application is made for permission to operate an electric railway in certain streets in the city of Milwaukee, and a fare of five cents, with the commutation system now used by the Milwaukee Electric Railway and Light Company, giving six tickets for twenty-five cents, or practically a four-cent fare, is agreed upon.

MEDIA, PA.—At a stated meeting of Collingdale Borough Council Monday night an ordinance was adopted on final reading giving the Philadelphia & Garrettford Street Railway Company, which is a subsidiary line of the Philadelphia & West Chester Traction Company, the right to connect its tracks with those of the Darby, Media & Chester Street Railway Company, which is a subsidiary line of the Philadelphia Rapid Transit Company, thereby enabling these companies to operate a through, high-speed joint service over their respective tracks between Chester and the Sixty-ninth Street terminal of the Market Street Elevated, Philadelphia.

HOOD RIVER, ORE.—The Valley Electric Railway Company, which is promoting an electric line out the west side of the valley into the Mount Hood country, organized today by electing officers, and announces that it will take up the work of pushing the road vigorously. The directors elected are: E. T. Folts (president), A. M. Kelly (vice-president), H. B. Langille (secretary), W. S. Gribble, G. W. Dimmick, O. H. Bailey and B. F. Gray. A large part of the right-of-way has already been secured, and the rest will be forthcoming as soon as the work of construction is commenced. A franchise to operate the proposed new road on the city streets is now pending before the City Council.

NEW MANUFACTURING COMPANIES

CLEVELAND, O.—The Fowler Electrical Supply Company of Toledo has been incorporated with a capital of $30,000.

LINCOLN, NEB.—The Korsmeyer Company, electrical supplies, has incorporated its business with a capital of $100,000.

NEW YORK, N. Y.—The Perfection Electric Manufacturing and Supply Company, of Brooklyn, capital $1,000, has been incorporated.

ALBANY, N. Y.—The Arkictyde Company, of Colonie, has been incorporated with a capital of $50,000, to manufacture electrical devices in conjunction with moving pictures. The directors are: William S. Milliken of Troy, James H. Burns, Frank W. Spreter, both of Cohoes.

ALBANY, N. Y.—The Duplex Non-Arcing Trolley Company, of New York, organized to manufacture electric trolleys and other mechanical devices, has been incorporated, with a capital of $2,000,000. The directors are Arthur O'Leary and Frederick J. Ryan, of Providence, and Walter R. Lee, of New York.

NEWARK, N. J.—The Electric Development Company has filed articles of incorporation in Newark. The concern is capitalized at $1,000,000, of which $1,000 has been paid in. The registered office of the company is with the New Jersey Registration Company at 525 Main street, East Orange. The incorporators are Howard Isherwood, Lester K. Holmes and William Huck, Jr.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

MARINETTE, WIS.—The Wisconsin Telephone Company will spend $5,000 in improvements this summer.

ANSLEY, NEB.—The North Clear Creek Telephone Company has been incorporated with a capital of $10,000.

CORN HILL, TEX.—The Corn Hill and Gravis Telephone Company has been incorporated with a capital of $30,000.

BILLINGS, MONT.—The Great Northern Railway is installing a telephone system of train dispatching between here and Virden. C.

NEWHOME, N. D.—The Sykeston and Newhome Telephone Company has been organized to construct about fifty miles of line.

MOAB, UTAH—The La Sai Mountain Telephone and Telegraph Company has increased its capital stock from $6,000 to $50,000.

PACIFIC GROVE, CAL.—The Pacific Telephone and Telegraph Company has commenced reconstructing and modernizing its lines.

CHAPPELL, NEB.—The Midland Telephone Company has been incorporated, with a capital of $2,000, by Swan Friskapp and others.

FLETCHER, OKLA.—The Fletcher Telephone Company has been incorporated, with a capital stock of $10,000, by R. C. Stout and others.

MARSHALLTOWN, IOWA—The Farmers' and Merchants' Telephone Company will erect a two-story fireproof exchange and office building to cost $17,000. C.

SAGINAW, MICH.—A new telephone company has been organized at Twining, to be known as the Twining Mutual Telephone Company, with a capital of $5,000.

CORNING, IOWA—John Anderson, manager of the local exchange, will install an aggregate of 20,400 feet of cable and other improvements approximating $10,000. C.

JOHNSTOWN, PA.—The Johnstown Telephone Company is to increase its capital stock by an issue of $100,000 to enable it to make some new extensions and some additions to its underground system, etc.

CRAWFORDSVILLE, IND.—The Home Telephone Company is in the market for material and wire to construct about two miles of conduit system. The company will make other extensions and improvements. S.

BELLINGHAM, WASH.—A new wireless station has been constructed on Sehome Hill to replace the one at the Byron Hotel. When the new station is complete direct communication can be had with San Francisco instead of through the Friday Harbor station, as is now being done.

PORTLAND, ME.—At the annual meeting of the Mexican Telephone and Telegraph Company, at Portland, May 5, stockholders will vote upon the question of issuing mortgage bonds, not exceeding the amount limited by statute, to provide means for new construction necessitated by the growth of the company's business, and to retire previous bond issues. Books close April 16 and reopen May 6.

DAWSON, GA.—Telephone exchanges at Cuthbert, Fort Gaines, Edison and Shellman have recently been purchased by Dr. J. G. Dean for approximately $30,000, including long-distance lines between all of the towns named. A number of improvements will be made. Doctor Dean formerly owned the Georgia-Alabama Telephone system, which he disposed of. The property is the largest in southeast Georgia. L.

BALTIMORE, MD.—The Radio Telephone Company has been granted a permit to erect a one-story building, thirty-five by thirty-five feet, and steel tower 350 feet high, on a lot on the east side of Milton Avenue, to be used as a local station for sending and receiving wireless telephone and telegraph messages and to cost about $2,500. The work of building the station will begin at once, and it is hoped to have it in working order by May 1.

PORTO BELLO, PANAMA CANAL ZONE—A wireless telegraph station, to be operated by the United States Navy Department, will soon be opened at Porto Bello. A contract for the equipment has been let and the materials are on the way to the Isthmus. A mast 130 feet high will be erected on one of the hills at the entrance to the harbor. The station will be used for general naval purposes and, in addition, official messages of the Isthmian Canal Commission will be transmitted between Porto Bello and the wireless station at Colon.

BOSTON, MASS.—The directors of New England Telephone announce the issue of $3,562,400 new stock, to be offered to stockholders at par, payment to be made July 16, 1909, and January 17, 1910. The proceeds of the new issue will be used for new construction, and to pay for construction already done, but not permanently financed. The present outstanding stock is $35,508,500, and the new issue will bring the total to $39,070,900. The company is earning enough to cover the increased dividend requirements, even though the expenditure of the proceeds should bring in no new revenue. With the stock at 135, the subscription rights, on the basis of one share of new stock for each ten shares now held, would be worth about $3 per share, a substantial extra dividend, which explains in part the reason why the stock has been selling relatively much above American Telephone, a fact that has caused more or less comment.

ELECTRICAL SECURITIES.

The continued activity in the stock market last week resulted in a further advance in prices, and the establishing of new high averages for the year. Public support of the advance was particularly lacking and it is understood that the speculation was almost entirely due to professional enterprise.

A further slight improvement is reported in the iron and steel industry, statistics of production showing a fairly good increase. It is expected that there will not be any conflict between the operators and miners and, in fact, all over the country there seems to be little indication of labor troubles. Trade in general continues to show a gradual recovery and while this may not be as rapid as the optimists may have had reason to expect, what improvement is noticed is of the staple order, and there is apparently no apprehension on the part of large investors of any setback during the coming heated term.

Dividends have been declared upon the following electrical securities: American Light and Traction Company; the regular quarterly dividends of one-and-one-half per cent on the preferred stock and two per cent on the common stock, both payable May 1. (The board of directors confirmed the action of the executive committee in voting to pay on November 1 next an extra stock dividend of ten per cent to holders of the common stock. This extra distribution will be made annually as long as earnings justify it.) Milwaukee Electric Railway and Light Company; the regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable April 30 to stock of record April 20. The regular quarterly dividend of one-and-one-quarter per cent on the preferred stock of the Electric Bond and Share Company has been declared, payable May 1, 1909, to stockholders of record at the close of business April 16. Montreal Street Railway; a regular quarterly dividend of two-and-one-half per cent, payable May 1 to shares of record April 10.

ELECTRICAL SECURITIES FOR THE WEEK ENDED APRIL 10.

New York:	*Closing.*
Allis-Chalmers common	15
Allis-Chalmers preferred	47½
American Tel. and Tel. Company	138
Brooklyn Rapid Transit	77⅜
General Electric	159½
Interborough-Metropolitan common	14⅞
Interborough-Metropolitan preferred	43½
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cable) common	77½
Mackay Companies (Postal Telegraph and Cable) preferred	73¾
Manhattan Elevated	144
Metropolitan Street Railway	23¾
New York and New Jersey Telephone	110
Western Union	69¾
Westinghouse Manufacturing Company	83

It is stated that Robert Mather, who is now abroad in the interest of the Westinghouse Electric and Manufacturing Company, of which he is the chairman of the board of directors, has been instrumental in the resale of about $3,000,000 of the short-term notes of the company which were placed abroad just before the panic of 1907. Speyer & Company of New York were identified with the transaction.

Boston:	*Closing.*
Edison Electric Illuminating	253½
Massachusetts Electric	72
New England Telephone (ex rights)	134½
Western Telephone and Telegraph pref	80
Philadelphia:	*Closing.*
Electric Company of America	12½
Electric Storage Battery common	45¾
Electric Storage Battery preferred	45¾
Philadelphia Electric	11¾
Philadelphia Rapid Transit	31⅛
United Gas Improvement	90⅛
Chicago:	*Closing.*
Chicago Telephone	132
Commonwealth Edison	112
Metropolitan Elevated preferred	46
National Carbon common	82
National Carbon preferred	120

The Commonwealth Edison Company will redeem, July 1, all outstanding Chicago Edison Company debenture sixes of March 1, 1893, through the Merchants' Trust Company.

PERSONAL MENTION.

J. S. PAVEAR, St. Paul, Minn., has been appointed general superintendent of the St. Paul system of the Twin City Rapid Transit Company. C.

JOHN W. FREEMAN has been appointed manager of the Sprague Electric Company's Pittsburg office to succeed F. W. Barry, who recently resigned.

CHARLES E. ELLIS, president of the Tenth and Eleventh Street Railway Company, Philadelphia, Pa., died suddenly on April 6 at his home in that city.

WILLIAM E. COLE, Fond du Lac, Wis., treasurer of the Eastern Wisconsin Railway and Light Company, died from pneumonia at the age of sixty-five. C.

SAMUEL INSULL, president of the Commonwealth Edison Company, of Chicago, sailed for London on March 30 for a month's visit to his old friends in that city.

THOMAS A. EDISON has been awarded the Adelskiold gold medal of the Royal Academy of Sweden for his inventions in connection with the incandescent lamp and the phonograph. This medal is given once in ten years.

JOSEPH MALLOY, who for the past year has been manager of the Tamaqua Electrical Supply Company, Tamaqua, Pa., controlled by Sheets & Daddow, of Pottsville, Pa., has bought out the Tamaqua branch of the company and will hereafter conduct it himself.

FRANK S. POND, who recently resigned as superintendent of the Woonsocket (R. I.) Electric Machine and Power Company after having held that position since this company was incorporated in 1883, has accepted a responsible position in the mechanical and electrical department of the Bliss-Baybian Company of Thorndike, Mass.

FRANK WELLS HALL has been appointed manager of the Philadelphia office of the Sprague Electric Company. Mr. Hall was formerly in the New York and Chicago offices of this company in engineering and sales capacities. His wide circle of acquaintances and his extensive business and engineering experience should win for him a large clientele in his new territory.

EMERSON McMILLIN, president of the American Light and Traction Company, has been elected to the newly created position of chairman of the board. A. P. Lathrop was elected president to succeed Mr. McMillin. J. M. McCarthy was chosen vice-president and treasurer in place of Mr. Lathrop, and Marion McMillin was elected a vice-president and assistant secretary, the other officers being re-elected.

EDGAR C. BRADLEY, manager of the Pacific Telegraph and Telephone Company, it is learned, recently carried $16,800,000 in securities from San Francisco to J. P. Morgan & Company in New York city. Mr. Morgan bought the bonds in San Francisco and the express company asked $15,000 to transfer them. Mr. Bradley found that he could charter a special car, hire two detectives to guard him, and bring the bonds safely through considerably cheaper than this figure.

WILLIAM BARCLAY PARSONS, who was recently elected a director of the Underground Electric Railway Company of London, has been in London for the last few days studying the condition of its system, and will shortly return to America to make a report thereon to the Speyer interest, which represents the American stockholders. Mr. Parsons is not new to the problem of underground travel in London, for five years ago he was appointed by the British government one of three engineers composing a royal commission which examined this problem with a view to the improvement of the service. His colleagues at that time were Sir Benjamin Baker and Sir John Wolfe-Barry. In a recent interview Mr. Parsons said that the New York subways were better than those of London, and that the underground railway system of Paris was superior to either.

E. H. STEVENS.

E. H. STEVENS, who is well-known among steam power-plant and central-station men, as the general superintendent of plants of the Public Service Corporation of New Jersey, has resigned that position to become vice-president and general manager of the Bird-Archer Company, 90 West Street, New York city. Mr. Stevens' genial disposition, courtesy and engineering ability have won for him the respect and esteem of all with whom he has come in contact, and his many friends wish him all success in his new work.

G. W. BERTHOLD, formerly secretary and superintendent of the Cuthbert Electrical Manufacturing Company, Chicago, has severed his connection with that concern to become president of the Electric Apparatus Company, of Chicago. Mr. Berthold will also practice as a consulting engineer.

NEW PUBLICATIONS.

THE ILLUMINATOR—The March issue of the *Illuminator*, edited by Milton Hartman, Schofield Building, Cleveland, Ohio, is full of interesting things concerning illumination and the application of the "Tungstolier." Among the contributions are "How to Get the Best Results from Tungsten Lamps," "Importance of Shadows," "Effect of Variation Table," and there are also some sprightly and incidental editorial paragraphs.

FOWLER'S MECHANICS' AND MACHINISTS' POCKET BOOK AND DIARY FOR 1909—This is a publication primarily designed for the workman, who will find it of great advantage to peruse constantly, although foremen, draftsmen and engineers in general will find it a handy little work of reference. The English price is 6d net, which seems almost impossible when one considers the standing of the editor, W. H. Fowler, and his experience in this line of work. The book is on the general style of all the practical engineers' pocket books, and contains over 400 printed pages, while much of the material is entirely new for works of this nature.

ELECTRICAL RULES OF THE MILLERS' MUTUALS—The 1909 edition of the "Rules of the Millers' Mutual Fire Insurance Companies Governing the Installation of Dynamos, Motors and Electric Lights in Flouring Mills and Elevators" has been published and is ready for distribution. On account of the hazardous nature of the risks the rules adapted for them have been made much more stringent than the National Electrical Code and for the benefit of the millers they have been simplified as much as possible. To make their meaning still more clear fifteen pages of the booklet have been filled with illustrations of approved and unapproved electrical fittings. The rules have been drawn up chiefly by Postel & Linn, Fisher Building, Chicago, Ill., consulting engineers for the companies.

DATES AHEAD.

Louisville Electrical Show. The Armory, Louisville, Ky., April 12-24.

Iowa Electrical Association. Annual convention, Cedar Rapids, Iowa, April 21-22.

Iowa Street and Interurban Railway Association. Annual convention, Cedar Rapids, Iowa, April 22-24.

American Electrochemical Society. Next meeting, Niagara Falls, Ontario, May 6-8.

Omaha Electrical Show. Omaha Auditorium, Omaha, Neb., May 6-15.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., May 20-22.

Nebraska Electrical Association. Annual convention, Omaha, Neb., May 11-13.

Arkansas Association of Public Utility Operators. Annual meeting, Hot Springs, Ark., May 12, 13, 14.

American Association of Electric Motor Manufacturers. Annual convention, Hot Springs, Va., May 17-20.

Ohio Society of Mechanical, Electrical and Steam Engineers. Annual convention, Canton, Ohio, May 21-22.

West Virginia Independent Telephone Association. Annual convention, Parkersburg, W. Va., May 27-28.

National Electric Light Association. Annual convention, Atlantic City, N. J., June 1-4.

Association of Edison Purchasing Agents. Annual convention, Atlantic City, N. J., June 1-4.

American Railway Master Mechanics' Association. Annual convention, Atlantic City, N. J., June.

Master Car Builders' Association. Annual convention, Atlantic City, N. J., June.

Canadian Electrical Association. Annual convention, Quebec, Canada, June 16-18.

Association of Railway Telegraph Superintendents. Next meeting, Detroit, Mich., June 23.

American Institute of Electrical Engineers. Annual convention, Thousand Islands, N. Y., June 28.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

NEW PROPOSALS.

STREET RAILWAY FRANCHISE, LOS ANGELES, CAL.—Bids will be received by the board of supervisors of Los Angeles, Cal., until April 26, for a street railway franchise on certain thoroughfares in this city.

BOILERS, GENERATORS, ETC.—The United States Engineer Office, Boston, Mass., will receive sealed proposals for boilers, engines, generators, electrical cable and switchboards until 12 m., April 26, 1909. Information and blank forms on application to the United States Engineer Offices, Boston, Mass., Seattle, Wash., Portland, Ore., and San Francisco, Cal.

OFFICERS' QUARTERS, FORT MISSOULA, MONT.—The office of the Constructing Quartermaster, Fort Missoula, Mont., will receive sealed proposals until 12 m., April 29, for the construction, plumbing, heating and electric wiring of the following reinforced concrete buildings: One four-set officers' quarters, one set field officers' quarters, four single sets company officers' quarters, two double sets company officers' quarters and one double barrack. Plans, specifications and information furnished on application. Envelopes containing proposals should be indorsed "Proposals for Construction," and addressed to Capt. C. D. V. HUNT, Constructing Quartermaster.

FORT D. A. RUSSELL, WYO.—The office of the Constructing Quartermaster, Cheyenne, Wyo., will receive sealed proposals, in triplicate, until 9:30 a. m., mountain time, April 24, for furnishing all labor and material required in the construction and remodeling of an electric-lighting system at Fort D. A. Russell, Wyo., including the following items: 1, Constructing primary, secondary, service, transmission, and street light lines, furnishing and installing cut-outs and street-lamp brackets, and installing transformers, removing parts of the old line; 2, furnishing and installing all tungsten lamps, switchboard and all apparatus for substation; 3, furnishing all wattmeters and transformers; 4, installing interior conduit, wiring, and arc lamps for electric lighting cavalry drill hall; 5, construction of a building for transformer substation, all in accordance with plans and specifications prepared in the office of the Quartermaster General, United States Army. Plans and specifications are on file in this office, and in the office of the Chief Quartermaster, department of the Missouri, Omaha, Neb.; Chief Quartermaster, department of Colorado, Denver, Colo.; Chief Quartermaster, department of the Lakes, Chicago, Ill.; Depot Quartermaster, St. Louis, Mo., and Quartermaster, Fort Leavenworth, Kan. Envelopes containing proposals should be indorsed "Proposals for Remodeling Electric Light System at Fort D. A. Russell, Wyo.," and addressed to Capt. V. K. HART, 15th Inf., Acting Quartermaster, United States Army, in charge of construction, Room 3, Keefe Hall, Cheyenne, Wyo.

INDUSTRIAL ITEMS.

THE McCOMBS ELECTRIC COMPANY, electrical engineers and contractors, announces the opening of their business at 581 Vanderbilt Avenue, Brooklyn.

THE DUBOIS IRON WORKS, Du Bois, Pa., with offices formerly at 1206 Park Building, Pittsburg, Pa., have removed into more commodious quarters at No. 1429, in that building.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has issued the April number of its miniature magazine, Lux, in which are shown some attractive interiors lighted by Nernst lamps.

THE GERMAN-AMERICAN ELECTRIC COMPANY, New York city, at a recent meeting elected the following officers: President, Clive Runnells; vice-president and secretary, B. V. Norton; treasurer, J. A. Lamon.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., has issued its catalogue and price list of "Lutz" Metal Molding, a compact metal raceway for electric wires; also a folder describing their "Circular Loom" flexible conduits.

THE RICHLAND ELECTRIC COMPANY, Mansfield, Ohio, has incorporated with a capital stock of $10,000. The company has acquired the business of the Hellyer Electric Company, of Mansfield, Ohio, and has purchased the latter company's stock, which will be removed to 31 Park Avenue West.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has issued a special catalogue listing a handsome line of tungsten fixtures, suitable for residence, store or office use. Many new and attractive designs are shown, which will be appreciated by the trade. This catalogue will be sent, on request, to those who are interested.

THE TUNGSTOLIER COMPANY, Cleveland, Ohio, has opened a large store and display room in Dallas, Tex. The company is located in the most desirable business section in Dallas, at 324 Main Street, and carries a complete line of tungstoliers and gas and electric fixtures. M. G. Whitman, from the company's Bureau of Lectures, is in charge of the Dallas branch.

THE CLARK INCANDESCENT LIGHT COMPANY, Detroit, Mich., is to enlarge its plant at Third and Porter streets to double the present capacity, and for this purpose has incorporated under New Jersey laws for $500,000. A branch factory will also be erected in New York city, where A. J. Clark, president of the company, has gone to look after the details of the enterprise.

THE NATIONAL METAL MOLDING COMPANY, of Pittsburg, Pa., has published a catalogue descriptive of its metal molding. Its construction, dimensions, weights and prices are given in detail for both straight molding and all attachments, including crosses, elbows, tees, wall and ceiling brackets, junction and outlet boxes, couplings, clamps, sockets and rosettes. The advantages of National metal molding are clearly stated and its applicability for general wiring purposes shown.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is prepared to furnish users of Emerson and Trojan fans with electrotypes showing fan motors suitable for newspaper advertising, and with street-car cards bearing the name of the dealer selling the apparatus. These are attractively printed in two colors, and the name and local address of the dealer actually selling Emerson fan motors will be printed on the cards by the Emerson company without charge.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued a finely illustrated bulletin (No. 47) entitled "Quality Telephone Cords." The bulletin, besides illustrations of the cords, contains views of the machines on which they are made. This company has also issued a folder, of interest to telephone men, illustrating and describing a new desk stand; also a bulletin (No. 45) on rural telephone line construction. Copies of these may be had on application.

LEONARD KEBLER, president of the Ward Leonard Electric Company, Bronxville, N. Y., paid a visit to Chicago last week. In an interview with a representative of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN at the offices of F. B. Badt & Company, the Western agents of the company, Mr. Kebler stated that business was improving constantly and prospects were very bright. The Ward Leonard Company's new specialties are meeting with favor, while the company's well-known standard products are in greater demand than ever before.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has published a handsome catalogue devoted to its "Standard" fans. The typography and printing of this catalogue are considerably above the ordinary; in fact, it is one of the handsomest pieces of trade literature which has been produced this season. Models of this company's excellent line are well illustrated with halftone engravings and a complete description accompanies each figure. Supplementing the descriptive matter is a complete price list of fan motors and parts. Some of the types illustrated and described are ceiling fans, desk fans, bracket fans, oscillating desk fans and exhaust fans, for direct and alternating-current circuits.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just issued a handsome publication (No. 4653), devoted to the Curtis Steam Turbine Generator, elaborately illustrated with interior views and cross-sections of various parts of turbine and generator, and also with pictures of numerous representative installations. The bulletin will be found to contain much of interest to the central station manager. This company has also ready for distribution pamphlet No. 3768, containing illustrations, descriptions, and list prices of motor-starting and speed-controlling devices, both automatic and non-automatic. All who are interested in motor drive will find it of advantage to peruse this publication.

C. O. SCHNEIDER & COMPANY, 103 State Street, Chicago, are making a very popular and successful adaptation of their "Firefly" flasher, with tungsten lamps. The tungsten filament flashes very rapidly, and when compared with the ordinary carbon filament lamp there is a decided time-lag noticed. The "Firefly" flasher in its standard size has a capacity for operating up to six twenty-five-watt tungsten lamps, or their equivalent, on either direct or alternating current. The "Firefly" socket is another adaptation of this principle which may be used for display and decorative work. The flasher is substantial and well-made, with large platinum-iridium contacts, and it is estimated that with the flasher in use there is about one-fourth less current consumed than when the lamps are burning constantly.

THE AMERICAN BOILER ECONOMY COMPANY, Philadelphia, which manufactures the Copes boiler feed regulator and the Copes pump governor, has been consolidated with the Northern Equipment Company, Old Colony Building, Chicago, Ill. The latter company will assume all obligations of the former company, including guarantees to replace free of cost any part of any Copes regulator that may develop a defect within five years from the date of purchase. The branch offices of the American Boiler Economy Company, viz.: Tribune Building, New York city; Oliver Building, Boston; 226 East Pleasant street, Baltimore, and the Frick Building Annex, Pittsburg, will be continued under the style of the Northern Equipment Company, while the sale of Copes regulators will be handled in Philadelphia by the Adjustable Grate Bar Company, North American Building. The Northern Equipment Company announces that it will continue to install the Copes regulators on sixty days' free trial.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in Bulletin 84, illustrates and describes electrical instruments of precision, including ammeters, voltmeters and wattmeters, for direct and alternating currents, and also compensated voltmeters, power-factor meters, polyphase ammeters and polyphase wattmeters, for alternating current. Horizontal edgewise, vertical edgewise, fan, round and portable types are shown. Potential and series types of switchboard instrument transformers are also described.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued, in its Bulletin 1613, a description of the hydroelectric development of the Great Northern Power Company, said to be the largest of its kind in the world. The latter company, by its improvement of the St. Louis River near Duluth, Minn., supplies the manifold industries at the head of Lake Superior. The bulletin is copiously illustrated and describes all features of this installation, which, when fully developed, will contain eight 13,500-horsepower turbines, direct-connected to three-phase generators.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) April 6, 1909.

916,961. FIELD SPOOL FOR ELECTRIC MOTORS. Edward H. Anderson, Schenectady, N. Y., assignor to General Electric Company. Filed January 11, 1904. The field coils of a direct-current series motor are wound on sectional metal spools, which make the coils act as choke coils to prevent sudden variations of the motor current.

916,975. PULL SOCKET. John R. Byrne, Schenectady, N. Y., assignor to General Electric Company. Filed August 1, 1905. Combined with a spring arranged to make and break contact with a lamp contact is a tumbler operatively engaging the spring and a sliding actuator for the tumbler.

916,981. PARALLEL OPERATION OF ROTARY CONVERTERS AND STORAGE BATTERIES. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. Filed September 13, 1907. The rotary has three field windings, a shunt and a series winding and one connected across the booster that is in series with the storage battery. These insure charging of the battery when the load is light and prevent excessive discharge from the battery when the load becomes heavy.

916,982. VOLTAGE REGULATOR. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. Filed May 12, 1908. Combined with an alternating-current generator are an exciter and a normal automatic voltage regulator therefor, a series booster and a differentially-wound motor for driving the booster.

916,983. REGULATING DEVICE FOR ALTERNATING-CURRENT CIRCUITS. Sven R. Bergman, Lynn, Mass., assignor to General Electric Company. Filed June 14, 1905. A constant-current transformer has a long and a short fixed coil in the primary circuit, and a long fixed and a short movable coil in the secondary.

916,988. SYSTEM OF DISTRIBUTION. Walter S. Bralley, Schenectady, N. Y., assignor to General Electric Company. Filed May 11, 1906. Sections of the circuit are independently connected to the source by an electromagnetically actuated circuit-breaker, combined with a differential relay, to disconnect the sections from each other upon a predetermined overload, and means for preventing the switch mechanism from again connecting them together for a predetermined interval of time.

916,994. ELECTRIC HEATER. George W. Carpenter, John Rasmussen and Frederick B. McCrosky, Ontario, Cal. Filed April 16, 1908. In the body of the iron are rounded grooves into which fit snug cores with flat tops whose windings are pressed down by insulation on the lid.

917,000. RHEOSTAT. Lewis S. Chapman, Schenectady, N. Y., assignor to General Electric Company. Filed June 24, 1908. A motor-starting-box and field-regulating rheostat has a pair of arms yieldingly held together till all armature resistance is cut out and then the movement is continued with one arm in the same direction.

917,003. SEMAPHORE SIGNAL. Arba G. Clark, Schenectady, N. Y., assignor to General Electric Company. Filed July 31, 1908. The semaphore arm is moved by a motor through speed-reducing gearing and a clutch.

917,005. BRUSH SUPPORT FOR DYNAMO-ELECTRIC MACHINES. Walter M. Coffman, Madison, Wis., assignor to Northern Electrical Manufacturing Company. Filed October 9, 1906. A vertical-shaft, direct-current motor has a bonnet for the upper bearing to which is attached a brush-supporting ring.

917,011. PRINTING TELEGRAPH. Albert C. Crehore, Yonkers, N. Y., assignor to Typewriting Telegraph Company, New York, N. Y. Filed January 16, 1905. Comprises a series of receiving magnets, each corresponding to a letter or character of the transmitted message, and selected and operated by two succeeding current impulses over a single line, each pair of impulses different from other pairs as regards strength or polarity.

917,017. MAGNETIC DEVICE FOR TELEPHONE SYSTEMS. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed January 6, 1904. Consists of a pair of parallel coils with armatures carrying contacts adapted to be closed when one relay is actuated and open when both relays are actuated.

917,018. ELECTRICAL APPARATUS AND METHOD OF MANUFACTURING AND OPERATING THE SAME. John T. H. Dempster, Schenectady, N. Y., assignor to General Electric Company. Filed August 23, 1904. The method of removing air from a condenser consists in immersing it in a bath of liquid insulating material and maintaining this under such pressure during the normal operation of the condenser that air contained in it is dissolved or taken up by the insulating material.

917,021. ILLUMINATOR. Henry L. De Zeng, Philadelphia, Pa., assignor to The De Zeng-Standard Company, Philadelphia, Pa. Filed March 19, 1908. A handle has an electric lamp connected with it, a lens carried by the lamp, a tip connected with the handle and a glass rod carried by the tip.

917,023. MOTOR-CONTROLLING DEVICE. George H. Dorgeloh, Schenectady, N. Y., assignor to General Electric Company. Filed June 24, 1908. An electromagnet is arranged to connect a resistance in parallel with the motor armature during a portion of the movement of the rheostat.

917,025. ELECTRIC SWITCH. Walter Drake and Lisle C. Hatch, Black Earth, Wis. Filed January 21, 1907. Comprises a number of contacts, a blade supported at either end, and pivotally mounted supports connected with the blade at or near the end.

917,031. INSULATOR FOR HIGH-TENSION TRANSMISSION LINES. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. Filed September 3, 1908. Has a petticoat with breakage grooves located in chords of segments of its periphery.

917,040. ELECTRIC TRANSFORMER FURNACE. Otto Frick, Saltsjöbaden, Sweden. Filed March 2, 1904. An induction furnace comprises a masonry base with an annular hearth forming the secondary circuit, a primary winding facing a horizontal side of the hearth, and a closed magnetic circuit, the limb of which is surrounded by the hearth and primary winding, and the other limbs of which leave a free space between the iron and winding.

917,041. CARBON-FEEDING DEVICE FOR ARC LAMPS. Robert Fritz, West Hoboken, N. J. Filed February 28, 1908. Combined with an inclined carbon which is fed downward by gravity is an abutment with a star wheel engaging the carbon and adapted to frictionally hold it against the abutment.

917,047. SECONDARY ELECTRIC CLOCK. Peter G. Giroud, New York, N. Y. Filed November 15, 1907. Renewed August 26, 1908. Combined with a clockwork is an electromagnet controlling a spring-actuated vibrating lever with a bar hinged to its free end and provided with a projection to engage the teeth on a wheel on the main arbor.

917,053. ELECTRIC HEATER. Robert L. Hailey, New York, N. Y., assignor to The Lowe Electric Company, New York, N. Y. Filed June 11, 1908. A flatiron consists of a trough-shaped body with a single layer of resistance wire clamped to the bottom plate, a sheet of insulation being interposed between them, and a metallic plate above the wire, insulated therefrom and forming a clamping plate.

917,061. FIRE-ALARM SIGNAL SYSTEM. Benjamin B. Hatch, Boston, Mass. Filed July 15, 1908. In the door of each alarm box is a frangible compartment containing a hook that operates a switch in the main circuit. Opening of the door renders the switch inoperative.

917,064. VENTILATING SUPPORT FOR ARMATURE TEETH. Truman Hibbard, Minneapolis, Minn. Filed November 17, 1905. Consists of a staple or U-shaped piece of metal having projections upon one edge adapted to enter an annular groove in the end plate.

917,069. CLAMPING EAR FOR TROLLEY WIRES. Ralph L. Hoffman, Schenectady, N. Y., assignor to General Electric Company. Filed October 8, 1907. Comprises a hanger, two jaws fulcrumed thereon, each having an elevated shoulder

at one side of the vertical plane of suspension and a nut for forcing down the shoulders.

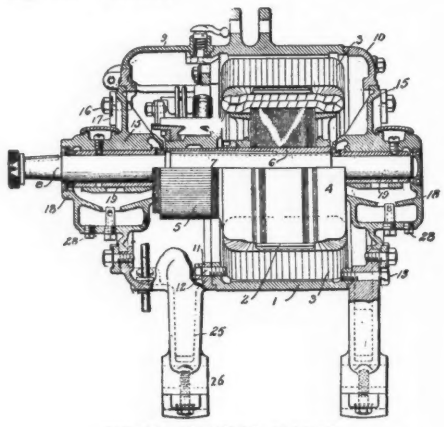
917,095. SPONGE INDICATING AND ALARM DEVICE. Frederick Mersfelder, Sr., Canal Dover, Ohio. Filed April 25, 1908. Means controlled by the sponge or dough operate a pawl and ratchet that governs a circuit closer in an alarm circuit.

917,099. ELECTRIC ARC LAMP. Berthold Monasch, Berlin, Germany, assignor to General Electric Company. Filed February 20, 1908. Combined with a main cathode that is a poor conductor when cold is an auxiliary cathode that is a good conductor and a fixed metal anode interposed between the two cathodes. The arc is first established between the auxiliary cathode and anode and is transferred to the main cathode when it becomes sufficiently heated.

917,103. WIRELESS TELEGRAPHY. Joseph Murgas, Wilkes-Barre, Pa. Filed October 7, 1905. An apparatus for transmitting messages, each made up of signal elements differing from the others in spark frequency, comprises a spark-producing circuit, a single source of alternating-current arranged to produce spark frequences corresponding to the various signal elements.

917,104. MAGNETIC-WAVE DETECTOR. Joseph Murgas, Wilkes-Barre, Pa. Filed September 29, 1908. Comprises a normally stationary magnet, a coil of conducting magnetic material rotatable in the field thereof, and means in inductive relation to the field for rendering the passage of oscillations manifest.

917,130. METER. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Filed May 4, 1904. A recording watt-hour meter has a spherical armature and circular field coils consisting of ribbon conductor wound on edge closely encircling the armature.



917,188.—TIRRILL MOTOR.

917,137. ILLUMINATING DEVICE. Charles A. Robinson, Sitton, Colo. Filed June 20, 1908. Two adjacent spheres, each irregularly studded with reflectors carrying incandescent lamps, are revolved by a motor at right angles to each other's axes.

917,138. MAGNETIC WEDGE. Conway Robinson, Schenectady, N. Y., assignor to General Electric Company. Filed January 8, 1907. A slot-closing wedge consists of a fiber backing having a central rib on one side and a filling of finely divided iron and insulating material on opposite sides of the rib, all being cemented together.

917,145. ELECTRICAL SIGN RECEPTACLE. Frank J. Russell, New York, N. Y. Filed December 11, 1907. Comprises telescoped cup members, a side plug contact and a center plug contact.

917,147. ARC LAMP. Robert H. Read, Schenectady, N. Y., assignor to General Electric Company. Filed August 23, 1906. Combined with a single arc-controlling magnet is a shunt around the arc including the magnet winding and a circuit-closer adapted to be closed by the clutch when the upper electrode drops.

917,159. FILAMENT FOR ELECTRIC INCANDESCENT LAMPS. Johannes Schilling, Halensee, near Berlin, Germany. Filed December 24, 1906. Is made by mixing a finely powdered refractory body and a finely powdered graphite with a solution of sulphide of ammonia to form a paste, forming this into a filament and passing a current gradually through it to drive off the gaseous constitutents.

917,163. WIRE SUPPORT. John F. Scott, Highland Park, Ill., assignor of one-half to Alphonsus L. Drum, Chicago, Ill. Filed November 5, 1906. Has a central post with a longitudinal web adapted for connection with the trolley wire at the lower edge and a cross web provided at its ends with hooks adapted to interlock with the span wire.

917,176. METHOD OF RECOVERING METALS. Walter O. Snelling, Pittsburg, Pa. Filed September 18, 1908. Tin is recovered from its oxide ores by disposing the ore in connection with an electrode in an electrolytic bath, reducing portions of the oxide to metal and thereafter connecting the metal as anode in the bath to dissolve the tin.

917,181. SINGLE-PHASE ALTERNATOR. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Filed June 10, 1907. Combined with the alternator is a reactive winding with connections for impressing on this winding a voltage displaced in phase from the terminal voltage of the alternator by an angle approximately equal to forty-five degrees, plus one-half the average angle of lag in the load circuit.

917,183. MOTOR-CONTROLLING DEVICE. John P. Tarbox, Washington, D. C., assignor to General Electric Company. Filed June 30, 1908. Comprises a controlling arm, an electromagnetic device responsive to changes in the motor current for automatically shifting the arm to vary the resistance, and a no-voltage magnet.

917,187. ELECTRICAL MEASURING INSTRUMENT. Elihu Thomson, Swampscott, Mass., assignor to General Electric Company. Filed November 13, 1908. A support has two flat coils suspended from adjacent points on it to swing freely and independently and to hang normally parallel to each other. There are means for supplying current to the coils to cause them to repel each other and to indicate their relative movements.

917,188. DYNAMO-ELECTRIC MACHINE. Leonard A. Tirrill, Lynn, Mass., assignor to General Electric Company. Filed November 19, 1904. An electric motor is provided with a field ring, heads secured to the ends thereof, a quill or sleeve, an armature and a commutator carried thereby, a shaft adapted to be reversibly inserted in the quill, with its power transmitting end at either side of the armature.

917,189. SYSTEM OF MOTOR CONTROL. John F. Tritle, Schenectady, N. Y., assignor to General Electric Company. Filed July 1, 1908. An induction motor has a liquid rheostat connected to its secondary circuit, means for causing a circulation of liquid through the rheostat, a number of electrically-operated valves arranged one above the other in the rheostat and means for controlling the valves in succession.

917,190. MOTOR-CONTROL SYSTEM. John F. Tritle, Schenectady, N. Y., assignor to General Electric Company. Filed November 14, 1908. Combined with a number of induction motors having resistances in series therewith are switches arranged to short-circuit sections of the resistances successively.

917,191. PROCESS FOR OBTAINING RADIO-ACTIVE BODIES FROM URANIUM OR THORIUM, ETC. Adriaan P. H. Trivelli, Scheveningen, Netherlands. Filed January 28, 1908. Consists of simultaneously exposing uranium, thorium, or their compounds, in a vacuum to the action of cathode rays and of radio-active bodies.

917,195. ELECTRIC OVEN. Tycho Van Aller, Schenectady, N. Y., assignor to General Electric Company. Filed May 28, 1906. Comprises a casing having a series of horizontal coils arranged in vertically parallel planes adjacent to each other, and means for pivotally supporting the material to be heated between the planes.

917,197. TRAMWAY-POINT. Edmund Veevers and George H. Butterworth, Liverpool, England. Filed April 11, 1908. Combined with an elbow lever movable synchronously with the point tongue is a solenoid adapted to pull the lever in one direction and a spring adapted to pull it the other way.

917,200. ELECTRODE FOR SEARCHLIGHTS. Hermann Viertel, Charlottenburg, Germany, assignor to Gebr. Siemens & Co., Lichtenberg, near Berlin, Germany. Filed October 25, 1907. The positive electrode has an oval cross-section and the negative electrode is directed from below toward and at an oblique angle to the positive one.

917,207. INSULATOR. August Weber, Jr., Schenectady, N. Y., assignor to August Weber, Sr., Schenectady, N. Y. Filed July 21, 1905. A pair of cylindrical porcelain members is provided with a screw aperture extending through both parts on one side of the axial line and wire-receiving grooves, complementary on the opposite side of the axial line.

917,209. SWITCH FOR ELECTRIC CIRCUITS. Edmund B. Wedmore, Rugby, England, assignor to General Electric Company. Filed October 16, 1906. Comprises a series of contacts, a pivoted controlling element adapted to engage them successively, and means carried by this element for tightening the same into close relation with the contacts.

917,212. ENVELOPE FOR VAPOR ELECTRIC CONDUCTORS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Company. Filed June 15, 1903. Consists of an exhausted outer tube, an inner tube of silica and co-operating electrodes.

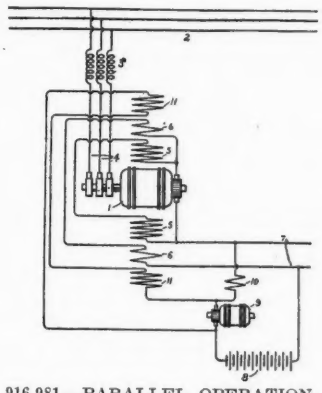
917,214. RINGER FOR TELEPHONE SYSTEMS. Klas Weman, Buffalo, N. Y. Filed February 6, 1908. Comprises an electromagnet, an armature, a yieldable suspension member carrying the armature at its free end, a gong and a hammer-tongue secured to the armature.

917,222. MOTOR-CONTROL SYSTEM. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Filed August 17, 1906. A car carries an engine, a generator driven thereby, and propelling motors connected to the generator through a line switch whose extended movement controls the generator field-resistance regulator.

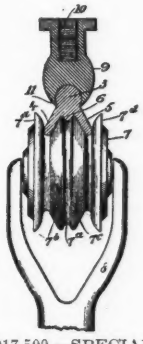
917,223. BRUSH-HOLDER. Eddy R. Whitney, Lynn, Mass., assignor to General Electric Company. Filed June 24, 1904. A supporting member and a brush-carrying member are pivotally connected with a helical spring.

917,224. INDUCTION-MOTOR. John B. Wiard, Lynn, Mass., assignor to General Electric Company. Filed February 20, 1906. A laminated rotor is provided with tunnels carrying a winding and switch contacts enclosed therein and connected in circuit with the winding. There are means so they may be controlled manually while the motor is running.

917,229. RECEPTACLE FOR INCANDESCENT LAMPS. Herbert C. Wirt, Schenectady, N. Y., assignor to General Electric Company. Filed February 27, 1906. A wall socket is provided with terminals inserted in it, spring clips in series therewith, and an enclosed fuse adapted to be inserted into and removed from the spring clips by movement at right angles to the axis of the fuse.



916,981.—PARALLEL OPERATION OF ROTARIES AND BATTERIES.



917,500.—SPECIAL GROOVED TROLLEY WIRE.

917,235. AUTOMATIC FIRE-ALARM BOX. Harry Anderson, Haddonfield, N. J. Filed October 6, 1908. Contains a motor, a circuit-breaker involving a movable contact member, and normally rotatable means operated by the motor for moving the contact member.

917,238. CANOPY-INSULATOR. Edmund E. Bechtold, Chicago, Ill. Filed July 19, 1907. Combined with a canopy having an external annular bead at a distance from its rim is insulating material resting at one of its edges on the bead.

917,241. APPARATUS FOR ELECTRIC HEATING DEVICES. Friedrich Bölling, Frankfort-on-the-Main, Germany, assignor to the Prometheus Electric Company, New York, N. Y. Filed November 5, 1908. Consists of an insulated resistance strip, a heat-conducting covering partially enclosing it, a sheet metal strip adjacent to the uncovered portion, an asbestos covering on one side of the strip, and a second heat-conducting covering of two like U-shaped pieces enclosing all the parts and pressed down upon them to form a unitary structure.

917,263. TELEGRAPH-REPEATER. Charles E. Davies, Ottawa, Ontario, Canada. Filed March 11, 1908. Combined with the main lines are compound electromagnets and auxiliary circuits including a winding of the magnets and controlling armatures, means operated by the movement of each armature for simultaneously breaking the auxiliary circuit that energizes the magnet controlling the opposite armature.

917,272. DRY BATTERY. Claude D. Enochs, La Crosse, Wis. Filed May 26, 1906. Comprises a thin shell having an inner coat of waterproof material forming a film on its inner wall and a thick settlement at its bottom, a thin zinc plate united with the shell by the coat, an inner carbon electrode and electrolyte packed within the lining, the upper portion of which is folded over the compound and around the upper end of the carbon.

917,277. COIN-CONTROLLED MECHANISM. James L. Ferguson, Parkersburg, W. Va. Filed May 2, 1908. A motor circuit as stop contacts for arresting a coin in the chute. Means actuated by the motor operate the coin receiver.

917,325. RECEPTACLE OR THE LIKE FOR CONDUITS. George A. Lutz, New York, N. Y., and Clarence C. Sibley, Perth Amboy, N. J. Filed October 26, 1905. This metal molding has a base provided with electric fittings, a strip engaging the sides of the conduit and means rotatively connecting the strip with the base so that the strip may engage the conduit.

917,326. MEANS FOR HOLDING RECEPTACLES AND THE LIKE TO CONDUITS. George A. Lutz, New York, N. Y. Filed February 23, 1907. A cap for metal molding has a lip adapted to be adjusted in the direction of its length, and means for adjustably holding the lip upon the cap.

917,327. BASE FOR SUPPORTING SWITCHES AND THE LIKE UPON CONDUITS. George A. Lutz, New York, N. Y. Filed February 23, 1907. The base is provided with slots to receive screws and movable holding pieces supported in line with the slots and independent of the screws.

917,328. OUTLET OR JUNCTION BOX. George A. Lutz, Plainfield, N. J. Filed July 23, 1908. Combined with a metal molding and box is a cap having depending walls to overlap the box walls and means to engage the walls of the conduit to retain the cap in place.

917,342. JUNCTION-BOX COUPLING. Edward S. Morrell, Philadelphia, Pa. Filed July 24, 1908. A non-threaded junction box and conduit pipe are joined by a nut and a nipple clamped to the conduit pipe by the advance of the nut, the box being clamped between the nipple and nut.

917,348. WALL-SWITCH. William J. Newton, Lynbrook, N. Y., assignor to Metropolitan Switchboard Company. Filed July 21, 1908. The switch blade is moved by a spring and rocker arm and controlled by a detent having a horizontal cam slot, in which slides a pin on the rocker.

917,356. PORTABLE HOIST. James L. Pilling, Chicago, Ill. Filed July 10, 1908. Comprises an inverted U-shaped housing, a hoisting drum journal therein, a motor field attached to the interior of the drum and an armature geared to the drum by a combination of spur, bevel and worm gearing.

917,367. MASSAGE INSTRUMENT. John W. Scott and Daniel Tibbals, Granite City, Ill. Filed May 13, 1908. A massage implement has a handle containing an induction coil, interrupter and battery, each separately removable from the handle and provided with terminals to complete the circuit between them by direct contact.

917,372. MEANS FOR ATTACHING ELECTRIC-LAMP SOCKETS. William S. Stapley, Bridgeport, Conn., assignor to Bridgeport Brass Company, Bridgeport, Conn. Filed October 1, 1908. A fixture having a threaded hub and a flange is joined to the hub of a cap by means of a nut.

917,394. PROGRAM-CLOCK. Harry B. Wilson, Milwaukee, Wis. Filed May 6, 1907. Adjacent to the dial is a set of circuit-closers located at various distances and a set of contact plugs of different lengths fit perforations in the dial and are adapted to project into the path of various of the circuit-closers.

917,396. CAR-TROLLEY. Agostino Zaccaria and Antony Belvedere, Uniontown, Pa. Filed June 9, 1908. The trolley harp has three diverging arms on each side provided with inwardly extended rollers at their ends to guide the trolley wheel.

917,401. EDGEWISE-WINDING MACHINE. Harold L. Barnholdt, Pittsfield, Mass., assignor to General Electric Company. Filed October 17, 1907. Comprises a rotatable hub carrying a number of grippers and a stationary plate carrying a circular recess with which the grippers co-operate.

917,411. WAVE-MOTOR. Secondo L. Casella and Philip M. Reynolds, San Francisco, Cal., assignors to National Power Company. Filed July 21, 1908. The wave-motor drives a dynamo through a series of cables.

917,445. TROLLEY. Albert S. Janin, New York, N. Y., assignor of one-third to Amelia Janin, Brooklyn, N. Y. Filed December 30, 1907. A pantograph trolley for locomotive consists of a collapsible diamond-shaped frame, which is spring and pneumatically controlled.

917,471. INDUCTION-MOTOR. Emil Mattman, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed March 17, 1906. A squirrel-cage rotor is provided with short-circuiting rings for the conductors, each ring consisting of two or more segments held by a dovetail connection to a support.

917,500. UNDER-GROOVED TROLLEY-WIRE. Louis Steinberger, New York, N. Y. Filed November 23, 1903. The wire has an oval body with integral sloping side webs, giving it a cross-section like that of an inverted angle-iron.

917,501. THIRD-RAIL INSULATOR. Louis Steinberger, New York, N. Y. Filed June 5, 1907. Mounted in the top of a petticoated insulator is a plate provided with a bolt and clamp for engaging the flange of the rail.

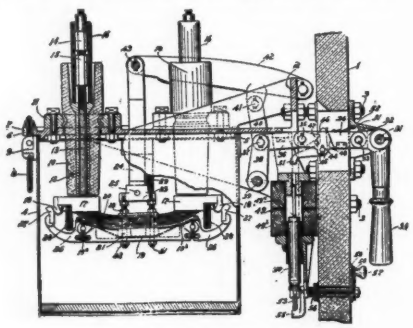
917,504. ELECTRIC HEATING APPARATUS. Gustav Teuber, Laasphe, Germany. Filed September 4, 1907. A heating plate has spiral passages formed in its base and is made of a mixture of quartz, white clay, feldspar and waterglass. A spiral heating resistance is inserted in the passages and a cover formed of the same ceramic paste is placed on top.

917,510. DYNAMO-ELECTRIC MACHINE. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed January 31, 1907. A high-speed rotor has groups of concentric coils located in the slots and is provided with end covers and bracing blocks for insulating and supporting the end portions of the coils.

917,535. BRUSH-HOLDER. Arthur J. Brown, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed July 30, 1906. Has a brush guide and a spring-actuated pressure finger pivoted at one end to the holder and having an outer free end with an adjustable member bearing on the end of the brush.

917,541. ELECTRIC SWITCHING DEVICE FOR RAILWAYS. Robert V. Cheatham, Louisville, Ky., assignor to Cheatham Electric Switching Device Company, Louisville, Ky. Filed June 25, 1907. Comprises a trolley pan with clamps, parallel strips uniting the clamps, the strips having inclined lower surfaces, with flat bars resting thereon and deflecting blocks above the bars.

917,542. SWITCH CONSTRUCTION. Herbert W. Cheney, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Filed August 25, 1905. An oil switch has an operating mechanism composed of two sets of toggle arms, one in two parts forming a collapsible member.



917,542.—OIL SWITCH.

917,548. COUPLING FOR ELECTRIC CONDUCTORS. Albert H. Conway, Mason City, Iowa. Filed May 3, 1907. A casing composed of detachably connected sections with a block of insulation, in each has contact rings provided with apertures at diametrically opposite points.

917,556. TROLLEY. Charles A. Dean, Homestead, Pa. Filed July 13, 1908. The trolley harp has retainer arms projecting upward on each side above the trolley wheel.

917,560. DRY-BATTERY CELL. Walter S. Doe, Jersey City, N. J., assignor of one-half to Harry N. Witbeck, Ravenna, Ohio. Filed May 11, 1908. A reservoir is sealed in the top of the enclosing zinc electrode and in contact therewith and is formed of two cup-shaped ring members.

917,564. SWITCH. William C. Dunn, Logansport, Ind. Filed May 22, 1908. A V-shaped throwing member is adapted to throw the switch when an armature is attracted by a magnet from the car.

917,574. DETECTING DEVICE FOR WIRELESS TELEGRAPHY. Reginald A. Fessenden, Brant Rock, Mass. Filed March 26, 1907. Renewed February 11, 1909. A terminal is supported in electrical contact with a moving liquid and is yieldingly mounted to resist the frictional stress of the liquid. There are means to give a signal when the position of the terminal alters by change in the friction due to electromagnetic waves.

917,584. AUTOMATIC MOVABLE ADVERTISING APPARATUS. Felipe Giroud, New York, N. Y. Filed May 8, 1906. A motor drives an advertising curtain intermittently and opens and closes the doors of the cabinet while the curtain is stationary.

917,587. ADVERTISING DEVICE. Hardy V. Good, Finsbury Circus, London, England. Filed March 24, 1908. On a subway or tunnel wall is mounted a series of successive pictures, each lighted by an electric lamp in succession as the train moves along, thus presenting a moving-picture effect.

917,632. RAILWAY-SIGNALING MEANS. Ralph J. Marshall, Newcastle-upon-Tyne, and William H. Penman, Gateshead-upon-Tyne, England. Filed April 18, 1908. Comprises two separate electric indicators on the car, each having separate circuit-closing switches operated by track devices to alternately actuate the switch-operating means.

917,633. TELEPHONE TRANSMITTER. Charles T. Mason, Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company, Sumter, S. C. Filed April 27, 1908. Between a cell containing variable resistances and the diaphragm are pin connections.

917,635. AUTOMATIC CALL-BELL. Arthur C. Mellinger, Hanford, Cal., assignor of one-half to Wesley E. Miller, Oakdale, Cal. Filed August 10, 1908. A disc on a clock stem has a number of pins movable radially outward and means for causing the pins to sound an electrical alarm at a predetermined time.

917,651. SPARKING DEVICE. David D. Peebles and Albert R. Thompson, San Jose, Cal. Filed October 24, 1908. The details of an ignition spark-plug are described.

917,700. RHEOSTAT. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. Filed November 16, 1905. A motor-starting and speed-regulating rheostat has a no-voltage magnet and an operating arm arranged to bring starting mechanism into running position so as to be held by the magnet and then to regulate the speed.

917,703. ELECTRIC RAILWAY-SIGNAL. William J. Ashley, Denver, Colo., assignor of one-sixth to Edwin C. Galbreath, one-sixth to Charles F. Seitz and one-third to Robert C. Albrook, Denver, Colo. Filed May 11, 1908. A normally open electric-light circuit and a normally closed magnet circuit are arranged along the track so that the latter circuit will be broken by disturbance of the track and the lamps thereby lighted.

917,707. PROCESS OF MAKING CARBIDE OR CARBIDE CONTAINING ELECTRODES. Henry S. Blackmore, Mount Vernon, N. Y. Original application filed April 11, 1906. Divided and this application filed April 23, 1907. Consists in mixing a metal carbide with a solid hydrocarbon containing a carbon-yielding compound and exposing the composition to the action of heat sufficient to dissociate the latter substance.

917,714. TROLLEY-POLE SUPPORTING AND CUSHIONING MEANS. Samuel C. Cooper, Johnstown, N. Y., and Walter M. Austin, Swissvale, Pa., assignors of one-third to said Cooper, one-third to Philip Keck and one-third to Sidney E. Trumbull, Johnstown, N. Y. Filed May 3, 1907. Combined with a trolley pole is a replacing mechanism, a pneumatic control therefor and a second pneumatic device forming the sole means for holding the pole in raised position.

917,735. ICE-CLEARING AND CONTACT WHEEL FOR ELECTRIC RAILWAYS. Frank E. Kinsman, Plainfield, N. J. Filed March 1, 1905. Has a bearing face of rounded convex cross-section and adapted to bear upon the third rail.

917,736. JUMP-SPARK IGNITION SYSTEM. Edwin S. Lincoln, Brookline, Mass. Filed December 5, 1907. Comprises a direct-current generator, an induction coil, an inductive resistance in circuit with the generator and the primary of the coil and a non-inductive resistance and condenser across the terminals of the primary.

917,742. TELEPHONE PAY-STATION. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Filed May 14, 1908. Coin-operated means are conjointly effective to control the circuit, there being means for effecting signals of different characters by coins of different demoninations.

REISSUE.

12,934. DIE FOR FORMING INSULATORS. Fred M. Locke, Victor, N. Y. Filed February 20, 1907. Original No. 838,727, dated December 18, 1906. Has a threaded stem and a flange surrounding it but spaced apart therefrom, thus forming an intervening annular space terminating at its base in a constricted annular air passage open to the atmosphere.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired April 13, 1909:

472,579. ELECTROMAGNETIC VALVE CONTROLLER. O. E. Lundstedt, Brooklyn, N. Y.

472,610. ELECTRIC SWITCH. L. T. Stanley, Brooklyn, N. Y.

472,623. ELECTRIC-LIGHTING SYSTEM. J. M. Lockwood, San Francisco, Cal.

472,628. DYNAMO-ELECTRIC MACHINE. L. S. M. Pyke and H. T. Barnett, London, England.

472,747. ELECTRIC ARC LAMP. R. E. Ball, New York, N. Y.

472,772. CIRCUIT FOR MULTIPLE SWITCHBOARD SYSTEMS OR TELEPHONE EXCHANGES. J. A. Seely, New York, N. Y.

472,909. ELECTRIC ELEVATOR. C. R. Pratt, New York, N. Y.

472,943. DYNAMO-ELECTRIC MACHINE. G. E. Dorman, Chicago, Ill.

472,956. CANOPY TELEPHONE-EXCHANGE SWITCHBOARD. C. E. Scribner, Chicago, Ill.